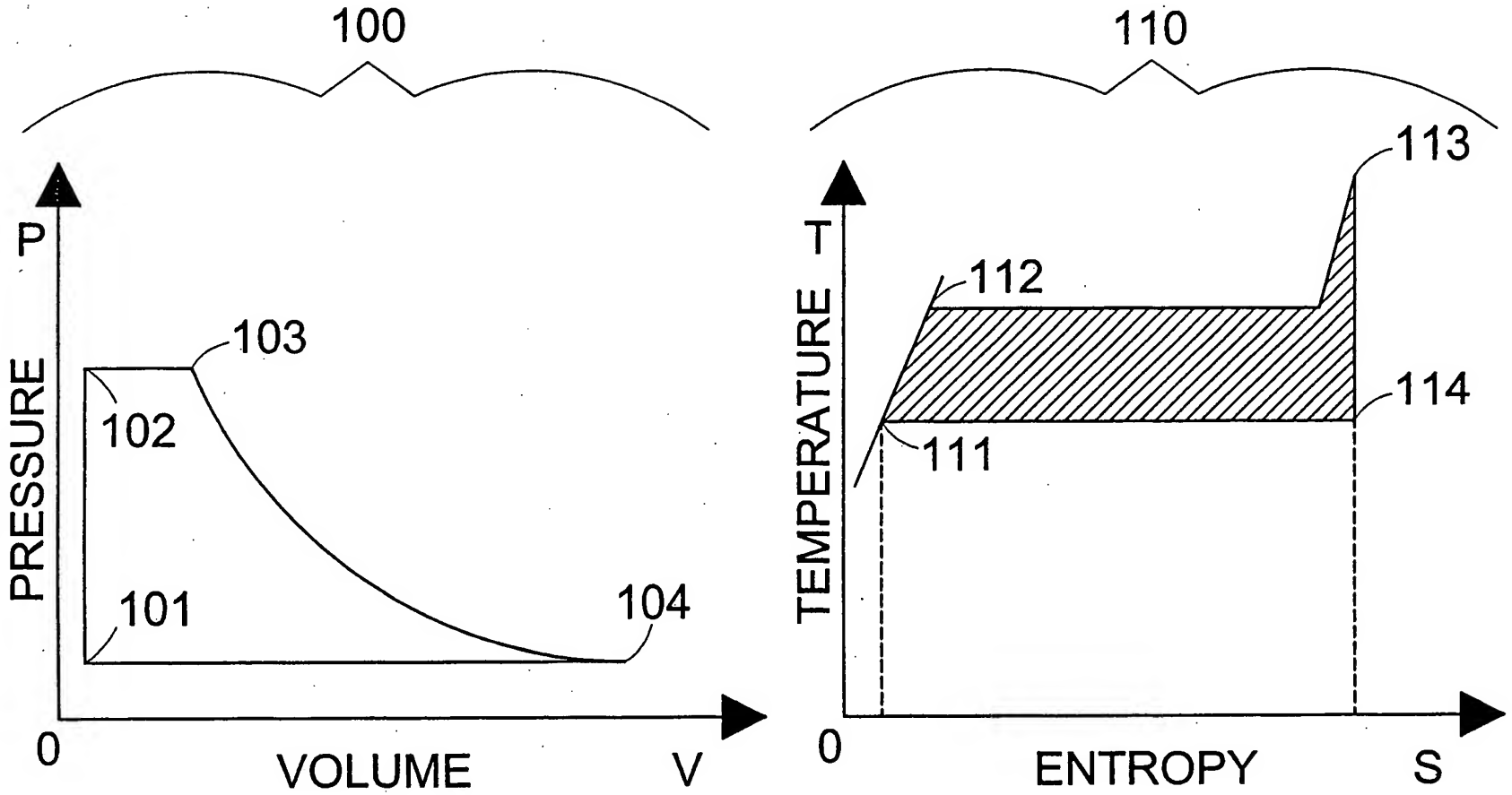
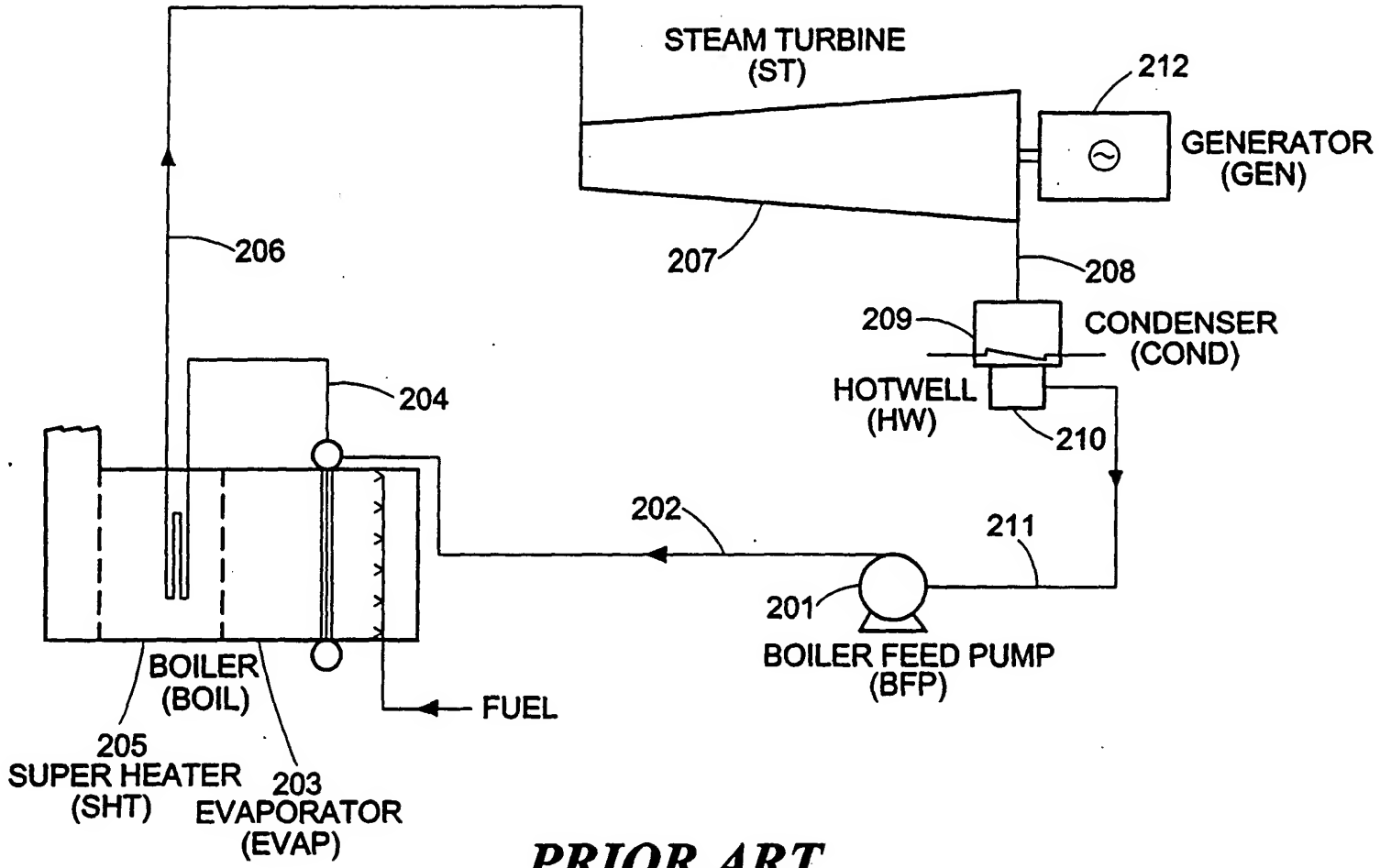
FIG. 1



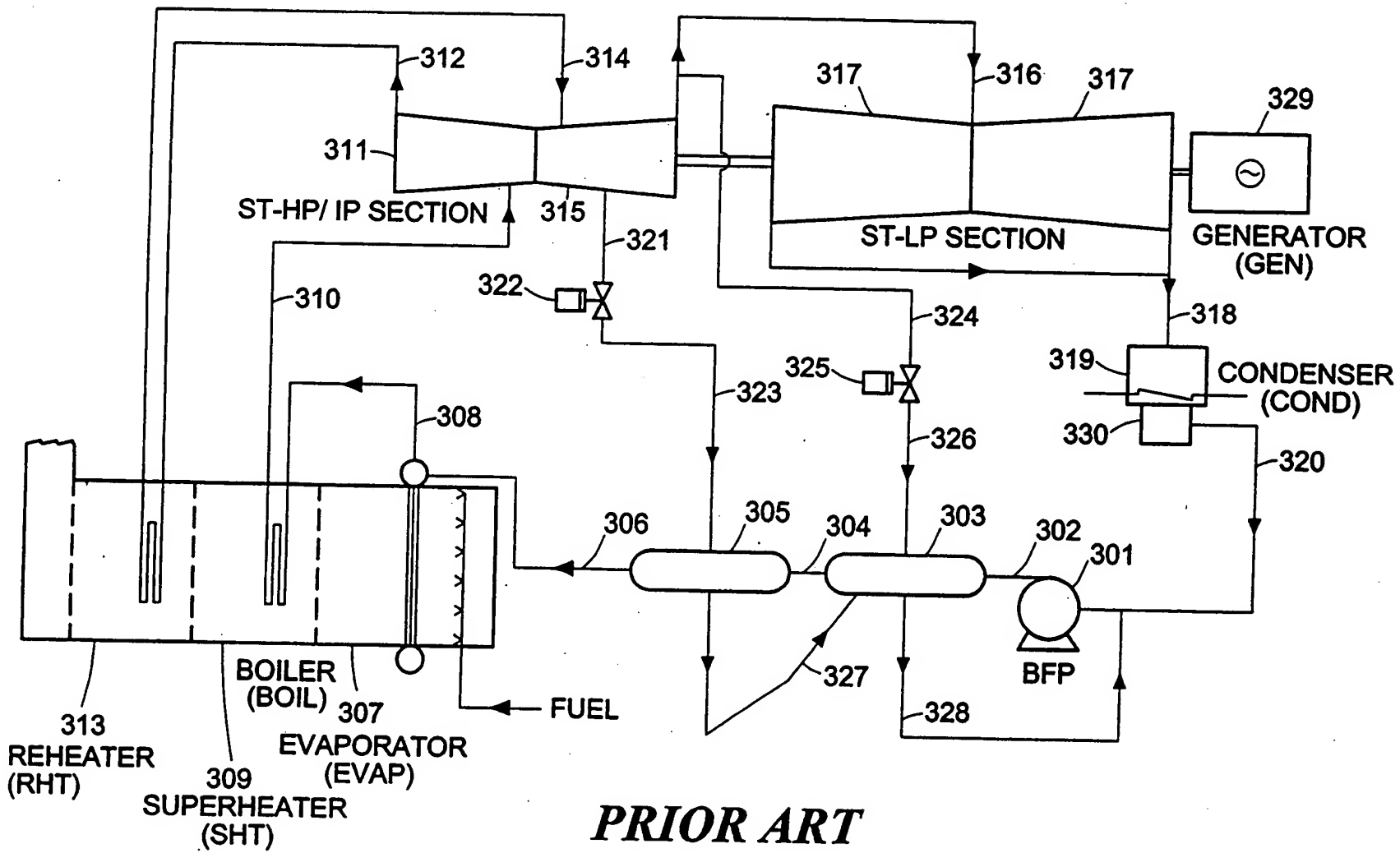
PRIOR ART

FIG. 2



PRIOR ART

FIG. 3



PRIOR ART

FIG. 4

Rankine Cycle Comparison

Option	Description	Inlet Press psia	Inlet Temp Degrees F	Reheat Press psia	Reheat Temp Degrees F	Exhaust Pressure psia	First Extract Flow %	Second Extract Flow %	Output BTU/ lbm	Input BTU/ lbm	Efficiency %	Efficiency Improvement %
1	Simple, No Reheat, No FWH	1800	1050	N/A	N/A	0.5894	N/A	N/A	586.7	1458.5	40.23%	Base
2	Reheat, No FWH	1800	1050	480.0	1050	0.5894	N/A	N/A	692.3	1642.4	42.15%	4.79%
3	Reheat, No FWH, Higher Press	2400	1050	640.0	1050	0.5894	N/A	N/A	701.0	1633.9	42.90%	6.65%
4	Reheat, With FWH	1800	1050	480.0	1050	0.5894	21.76	8.11	550.9	1257.1	43.82%	8.93%
5	Reheat, With FWH, Higher Pressure	2400	1050	640.0	1050	0.5894	24.81	7.95	539.1	1214.3	44.39%	10.35%
6	Supercritical, Double Reheat, No FWH	3860	1070	1029.0	1112	0.5894	N/A	N/A	850.5	1866.0	45.58%	13.30%
7	Supercritical, Double Reheat, With FWH	3860	1070	1029.0	1112	0.5894	8.72	14.12	731.8	1564.4	46.78%	16.28%

FIG. 5

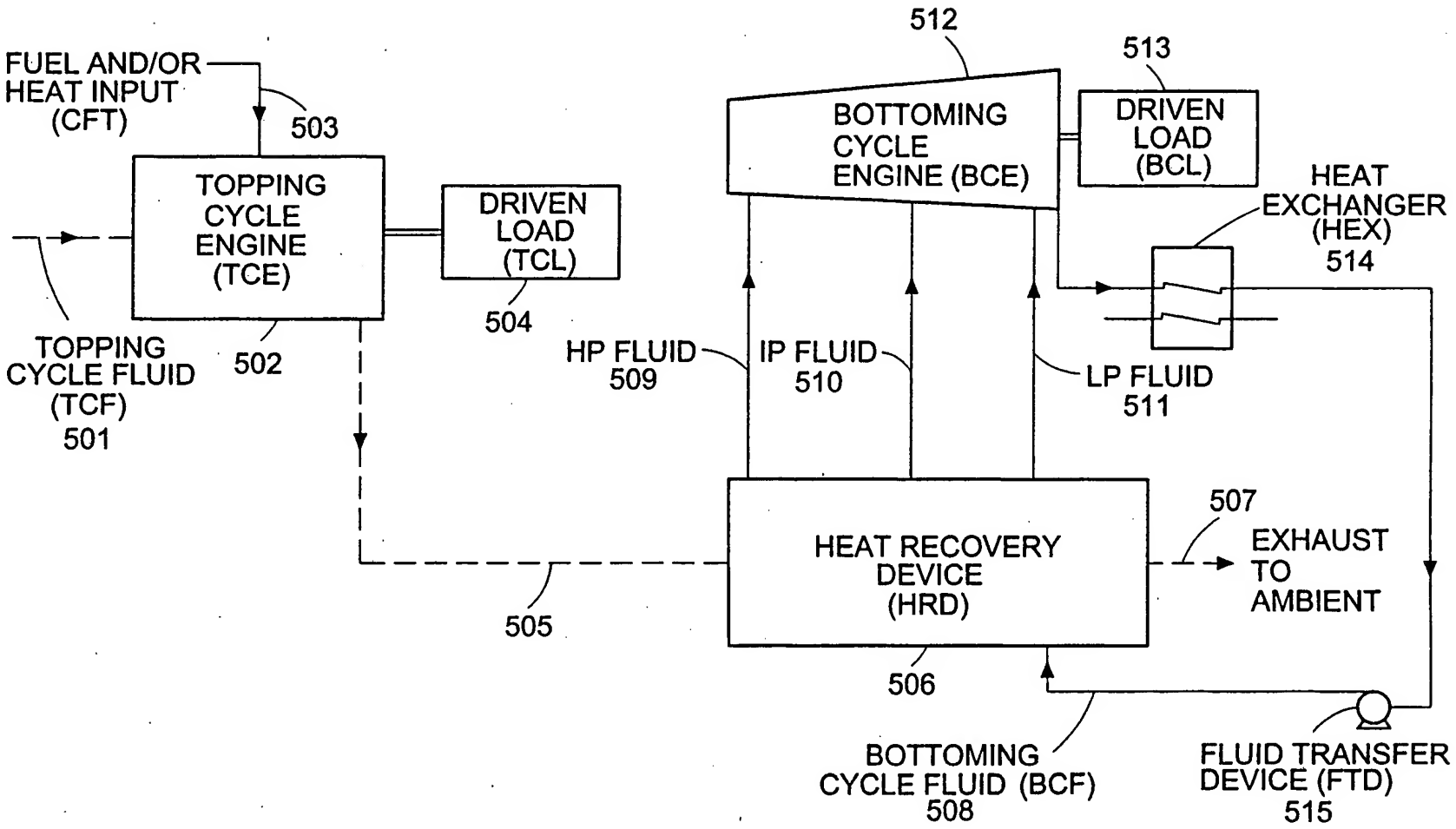
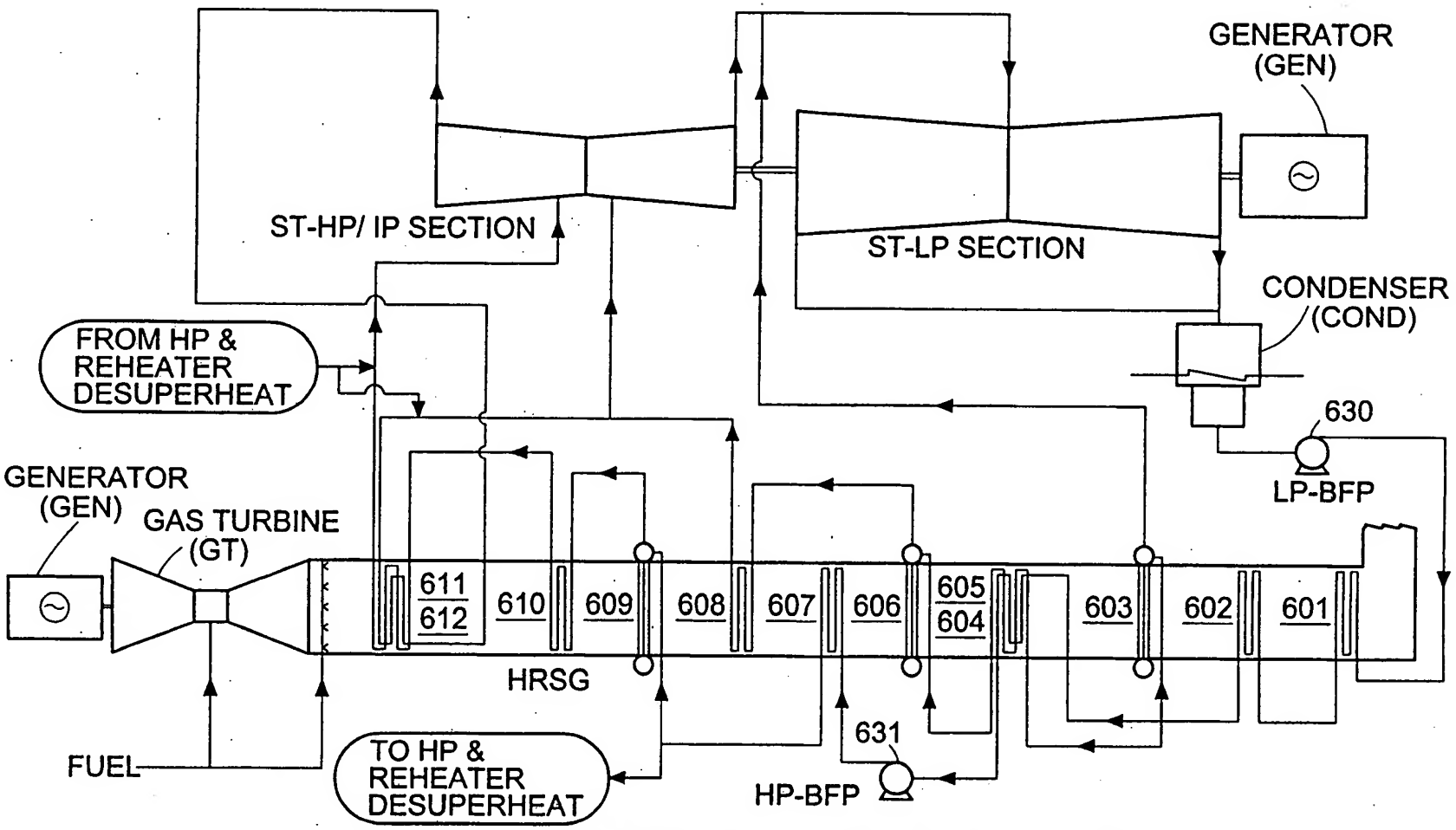

FUEL AND/OR HEAT INPUT (CFT)
503
TOPPING CYCLE ENGINE (TCE)
502
DRIVEN LOAD (TCL)
504
TOPPING CYCLE FLUID (TCF)
501
512
BOTTOMING CYCLE ENGINE (BCE)
513
DRIVEN LOAD (BCL)
HEAT EXCHANGER (HEX)
514
HP FLUID
509
IP FLUID
510
LP FLUID
511
HEAT RECOVERY DEVICE (HRD)
505
507
EXHAUST TO AMBIENT
506
BOTTOMING CYCLE FLUID (BCF)
508
FLUID TRANSFER DEVICE (FTD)
515

FIG. 6



CONVENTIONAL COMBINED CYCLE

PRIOR ART

FIG. 7

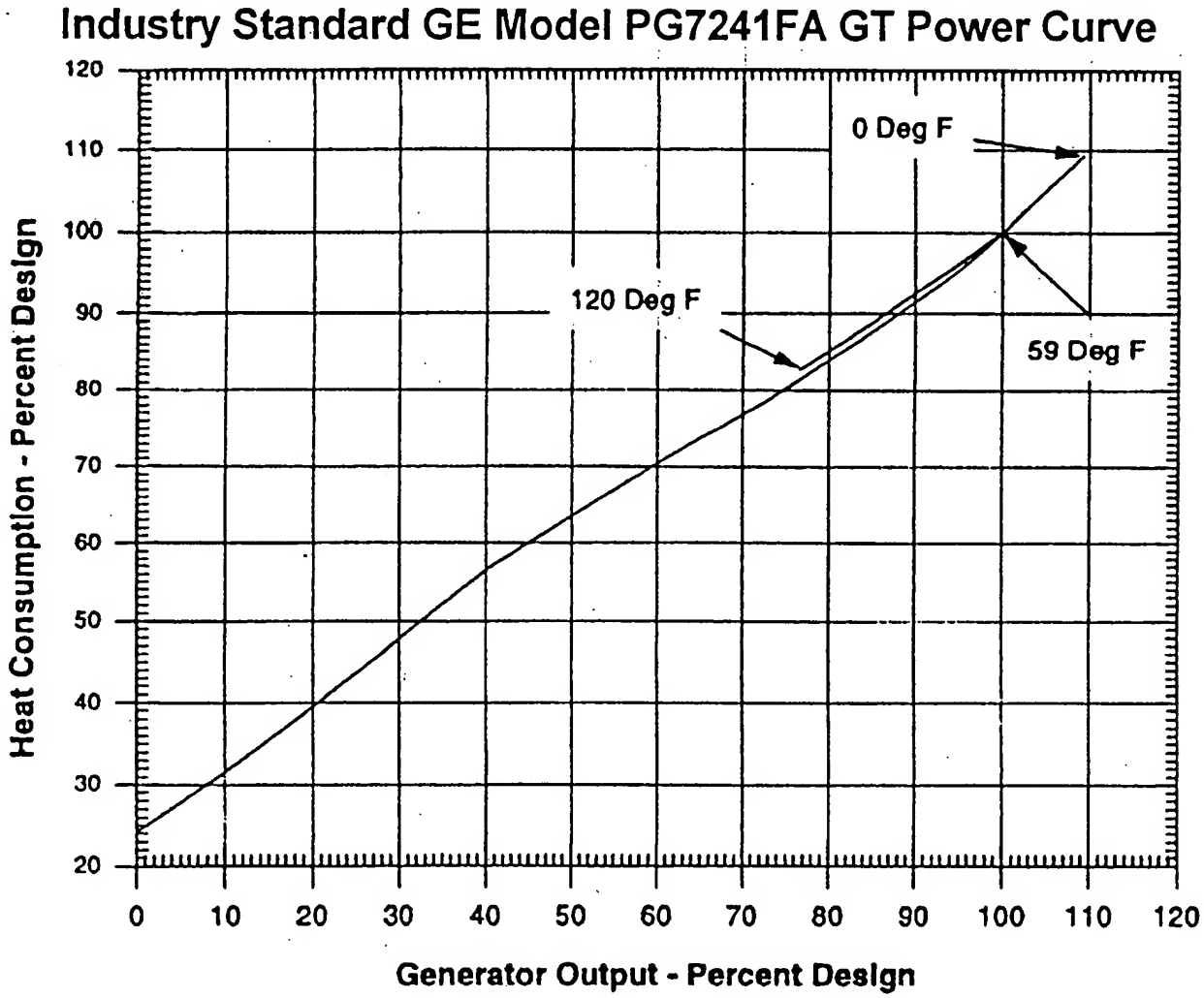
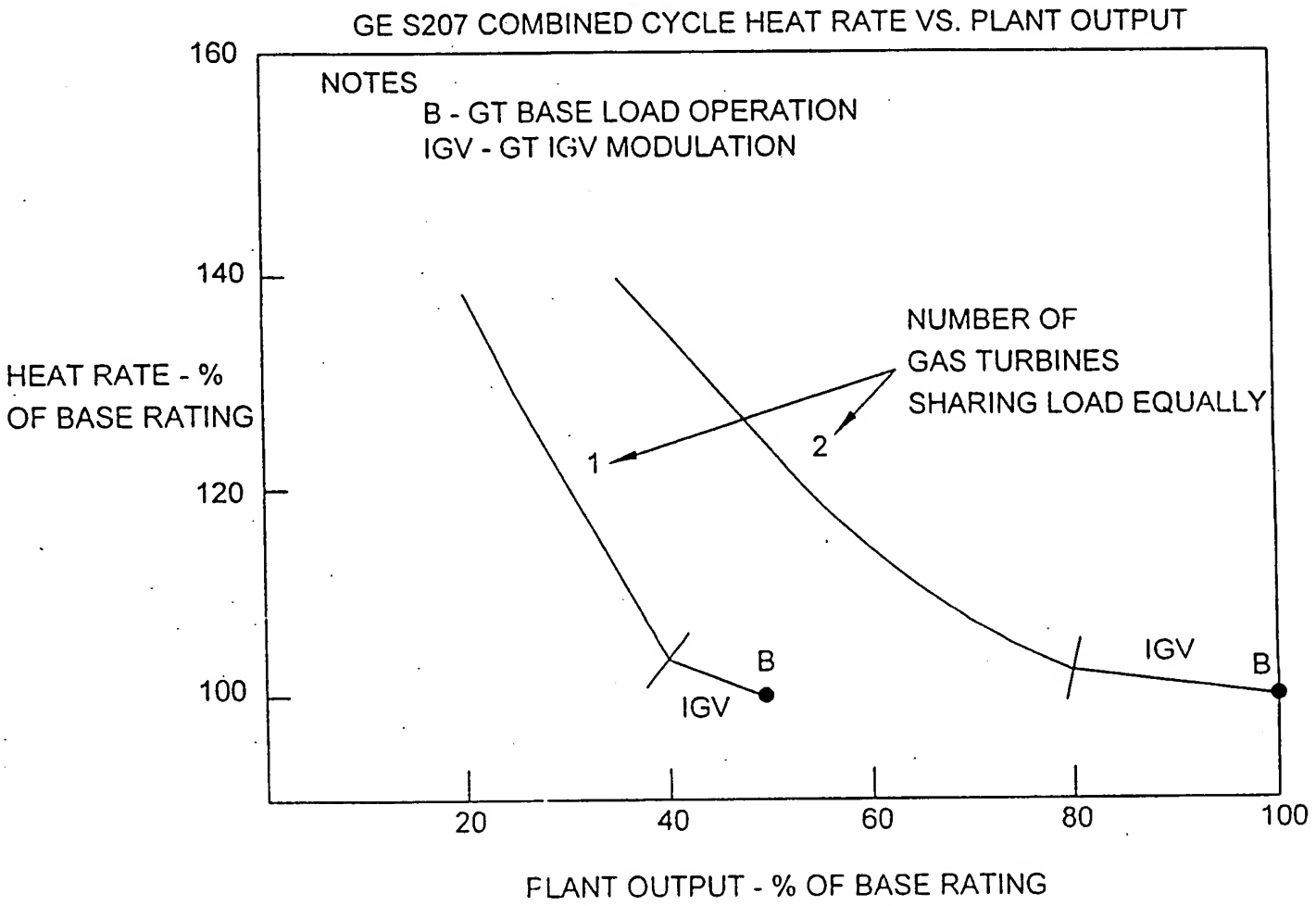

Industry Standard GE Model PG7241FA GT Power Curve
Heat Consumption - Percent Design
Generator Output - Percent Design
0 Deg F
120 Deg F
59 Deg F
120
110
100
90
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
100
110
120

FIG. 8


GE S207 COMBINED CYCLE HEAT RATE VS. PLANT OUTPUT
160
140
120
100
NOTES
B - GT BASE LOAD OPERATION
IGV - GT IGV MODULATION
NUMBER OF
GAS TURBINES
SHARING LOAD EQUALLY
1
2
B
IGV
IGV
B
HEAT RATE - %
OF BASE RATING
20
40
60
80
100
PLANT OUTPUT - % OF BASE RATING

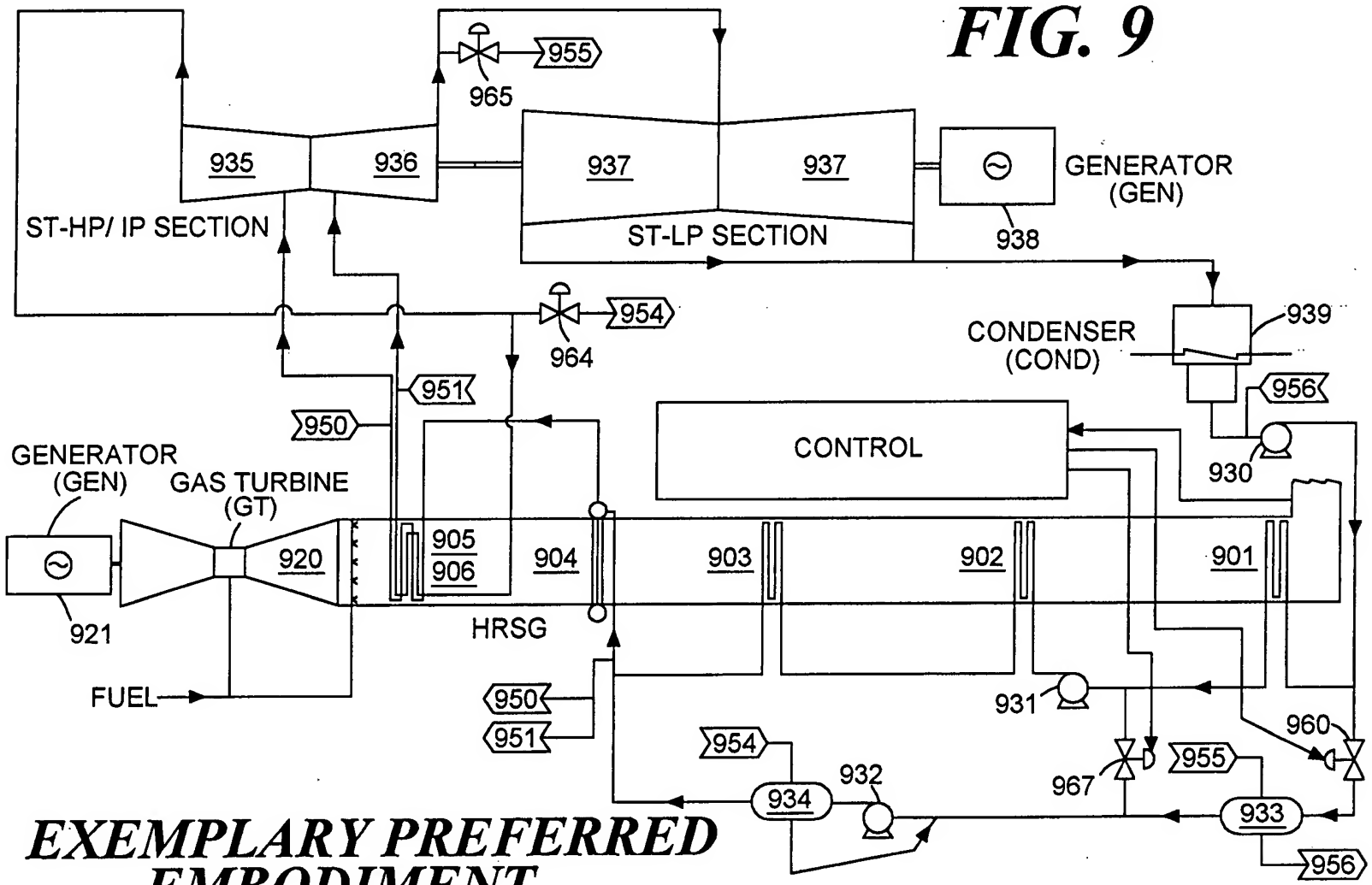


FIG. 9

EXEMPLARY PREFERRED EMBODIMENT

FIG. 10

Energy Flow Analysis Comparison

Option	GT Output (GTO) % of GTI	GT Loss (GTL) % of GTI	Supp Fire (SFE) % of GTI	HRSG Input (HGI) % of GTI	Exh Loss (HGE) % of GTI	HRSGL (HGL) % of GTI	HRSG Stm (HGS) % of GTI	SC Eff (SCE) %	Aux (AXF) Factor	STG Eff (1-SGL) %	ST Out (STO) % of GTI	Plant Eff (CCE) %	HR-LHV (PHR) BTU/kW
Prior Art	32.31%	11.48%	0.00%	56.21%	6.04%	0.50%	49.67%	38.78%	97.50%	99.00%	18.59%	50.90%	6040
Example	32.31%	11.48%	31.78%	87.99%	6.04%	0.82%	81.13%	44.39%	97.50%	99.00%	34.76%	50.90%	6041
SuperCrit	32.31%	11.48%	42.48%	98.69%	6.04%	0.93%	91.72%	46.78%	97.50%	99.00%	41.42%	51.75%	5942

Symbol	Description
GTI	GT Input Energy
GTO	GT Generator Electrical Output.
GTL	GT Losses for heat, auxiliaries, generator efficiency
SFE	Energy added through supplemental firing
HGI	GT exhaust energy at inlet to HRSG
HGE	Energy exhausted to atmosphere at HRSG outlet
HGL	HRSG heat loss to ambient
HGS	Energy in HRSG transferred to steam
SCE	Steam cycle basic efficiency
AXF	Factor to account for auxiliary loads in steam cycle
SGL	Steam Turbine generator losses
STO	Steam turbine generator electrical output
CCE	Combined Cycle plant efficiency
PHR	Overall plant heat rate base on LHV of natural gas

FIG. 11

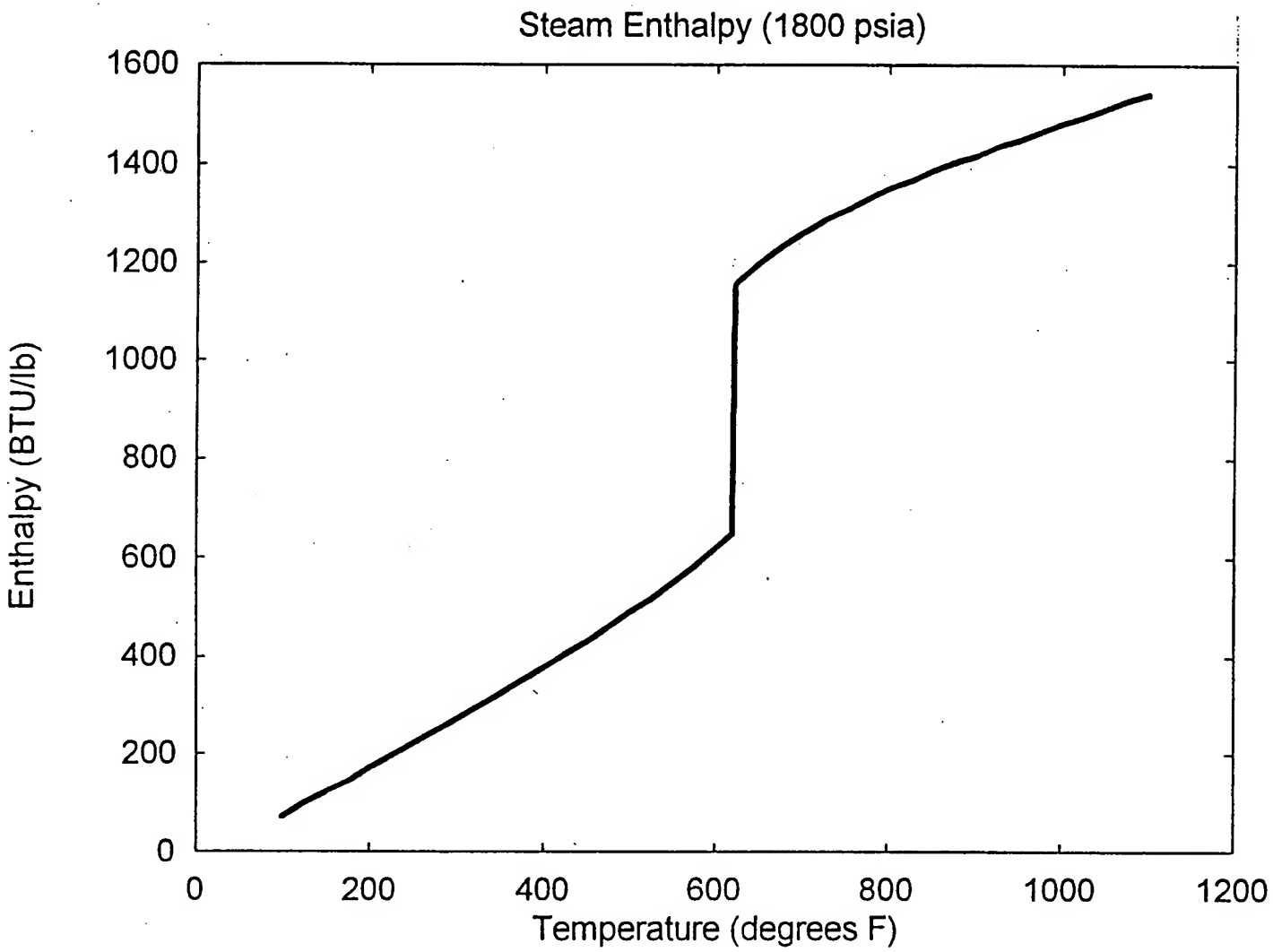

Steam Enthalpy (1800 psia)
Enthalpy (BTU/lb)
1600
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
Temperature (degrees F)

FIG. 12

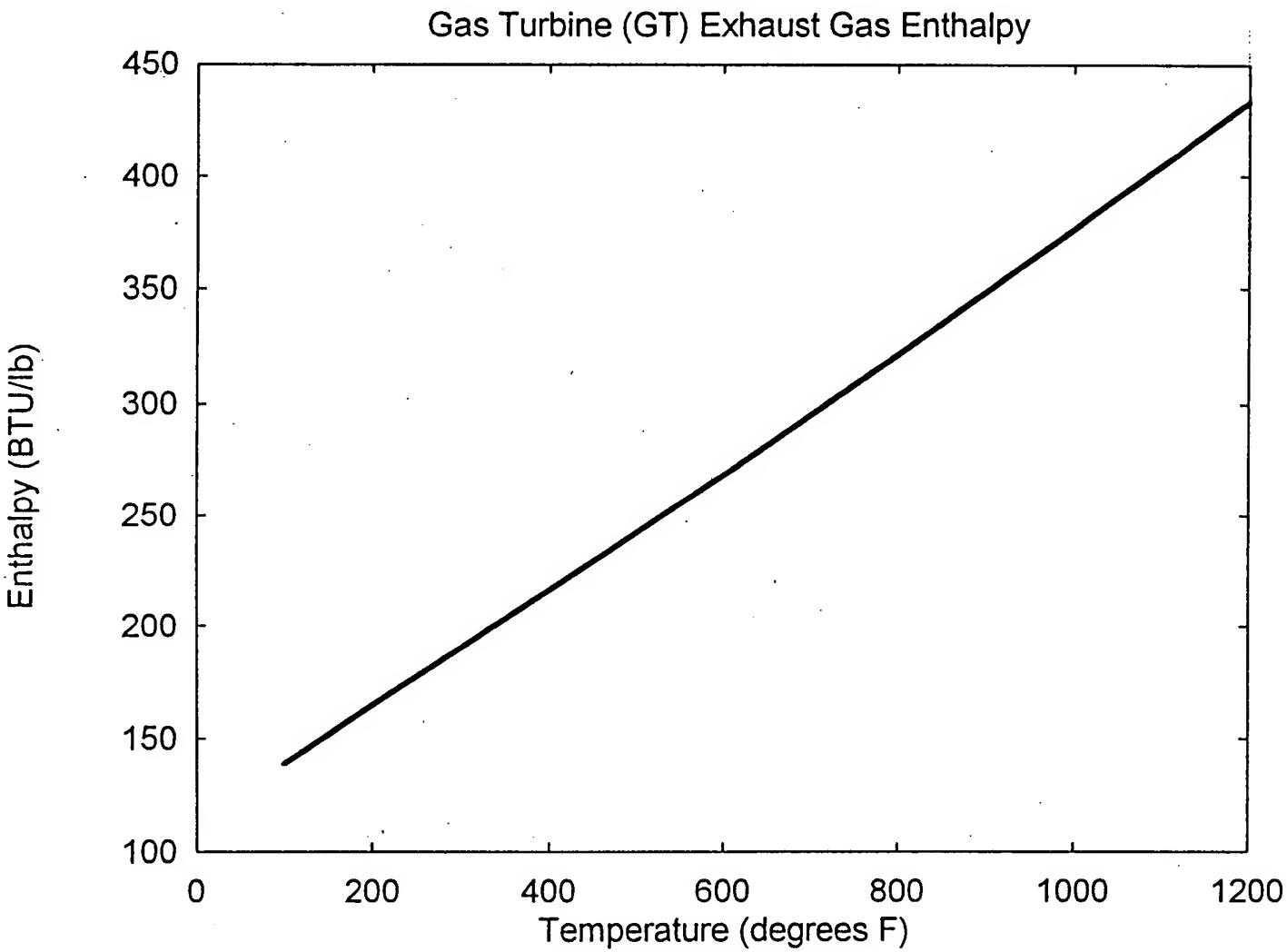
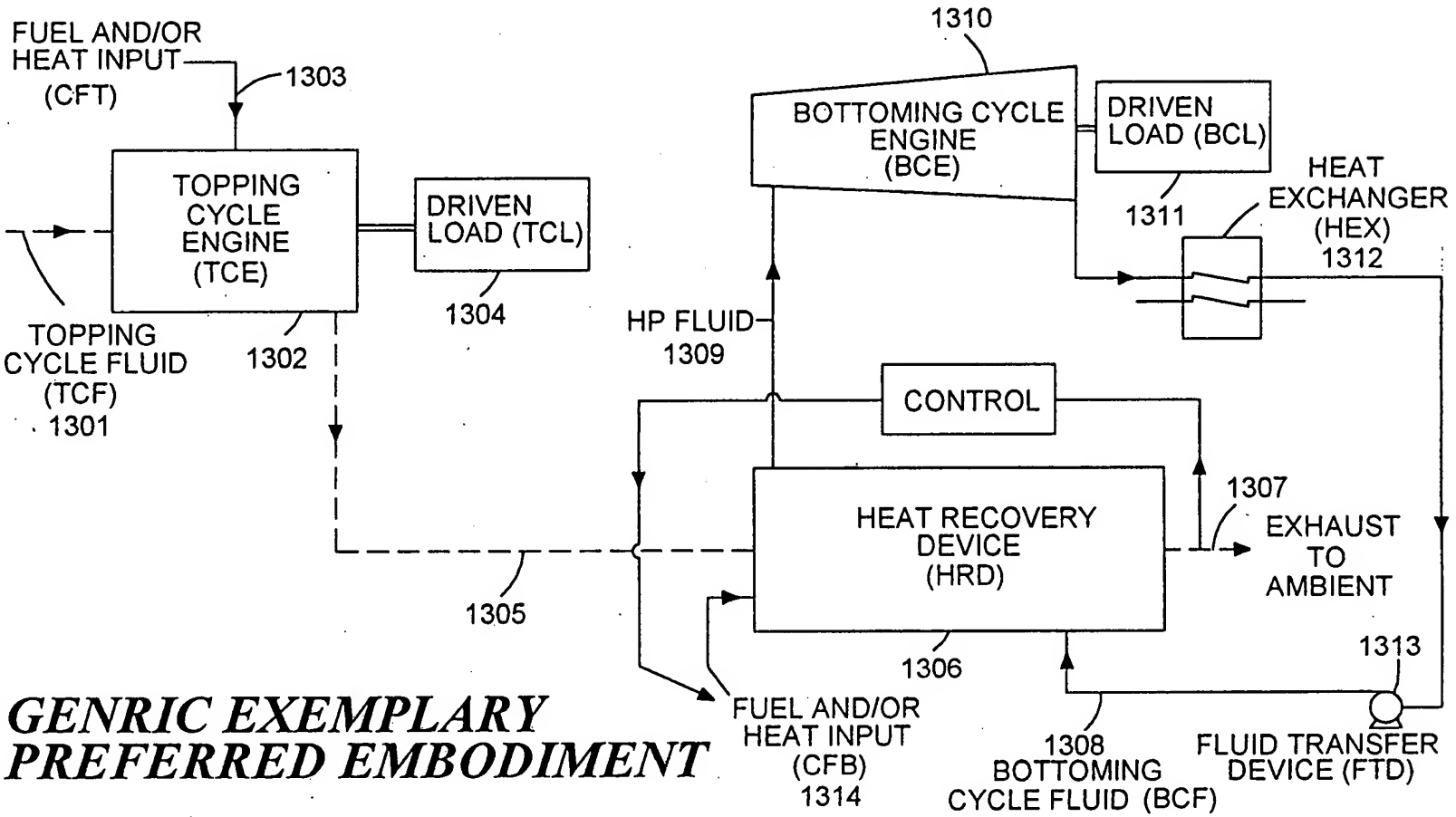

Gas Turbine (GT) Exhaust Gas Enthalpy
Enthalpy (BTU/lb)
450
400
350
300
250
200
150
100
0
200
400
600
800
1000
1200
Temperature (degrees F)

FIG. 13



GENRIC EXEMPLARY PREFERRED EMBODIMENT

FIG. 14

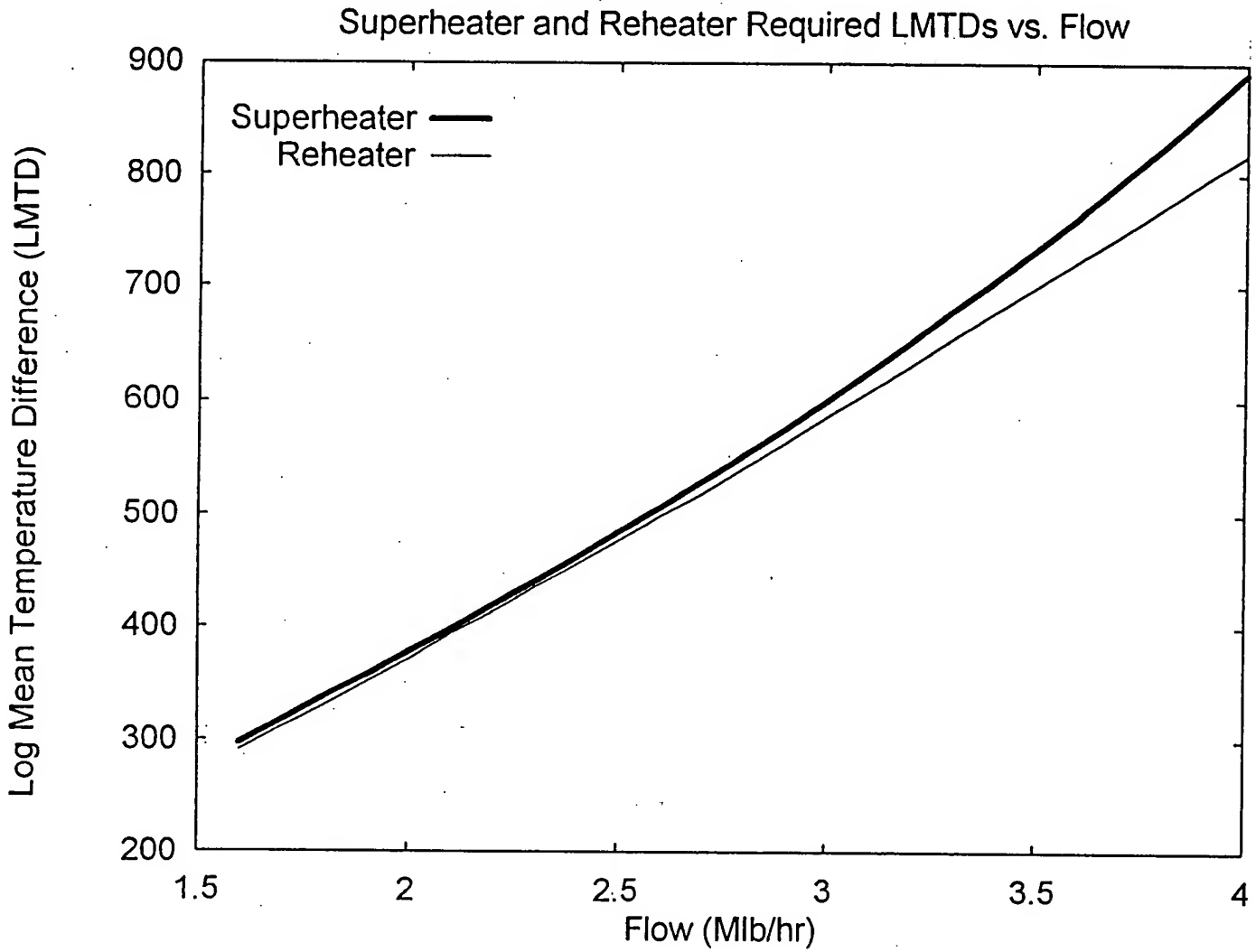

Superheater and Reheater Required LMTDs vs. Flow
Superheater
Reheater
Log Mean Temperature Difference (LMTD)
900
800
700
600
500
400
300
200
1.5
2
2.5
3
3.5
4
Flow (Mlb/hr)

FIG. 15

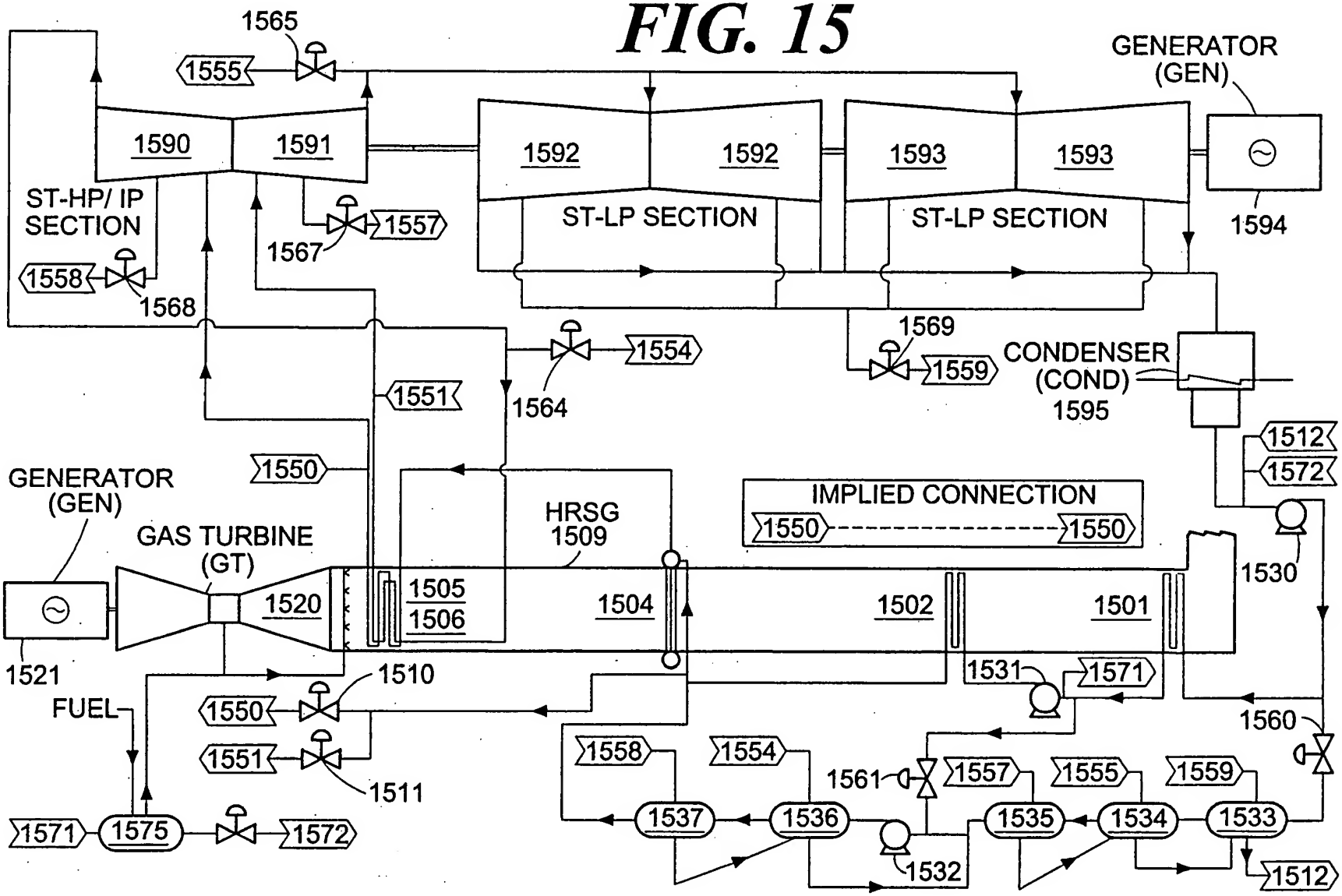
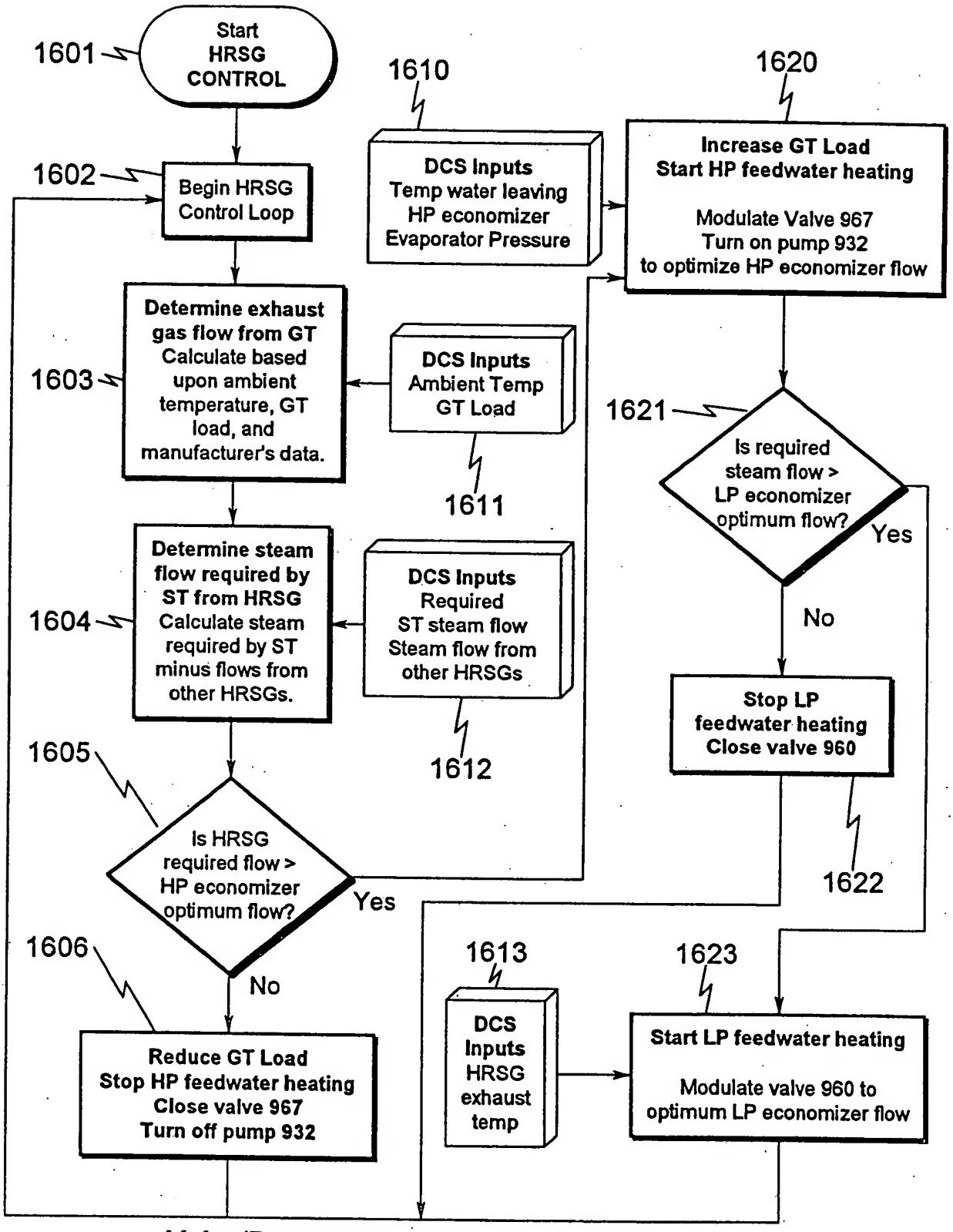

1565
1555
GENERATOR
(GEN)
1590
1591
1592
1592
1593
1593
ST-HP/ IP
SECTION
ST-LP SECTION
ST-LP SECTION
1594
1557
1567
1558
1568
1569
1554
1559
CONDENSER
(COND)
1595
1551
1564
1512
1572
1550
GENERATOR
(GEN)
IMPLIED CONNECTION
1550
1550
HRSG
1509
GAS TURBINE
(GT)
1530
1520
1505
1506
1504
1502
1501
1521
1531
1571
1510
FUEL
1550
1560
1551
1511
1558
1554
1561
1557
1555
1559
1537
1536
1535
1534
1533
1571
1575
1572
1532
1512

FIG. 16



Valve/Pump Numbers Refer to FIG. 9

FIG. 17

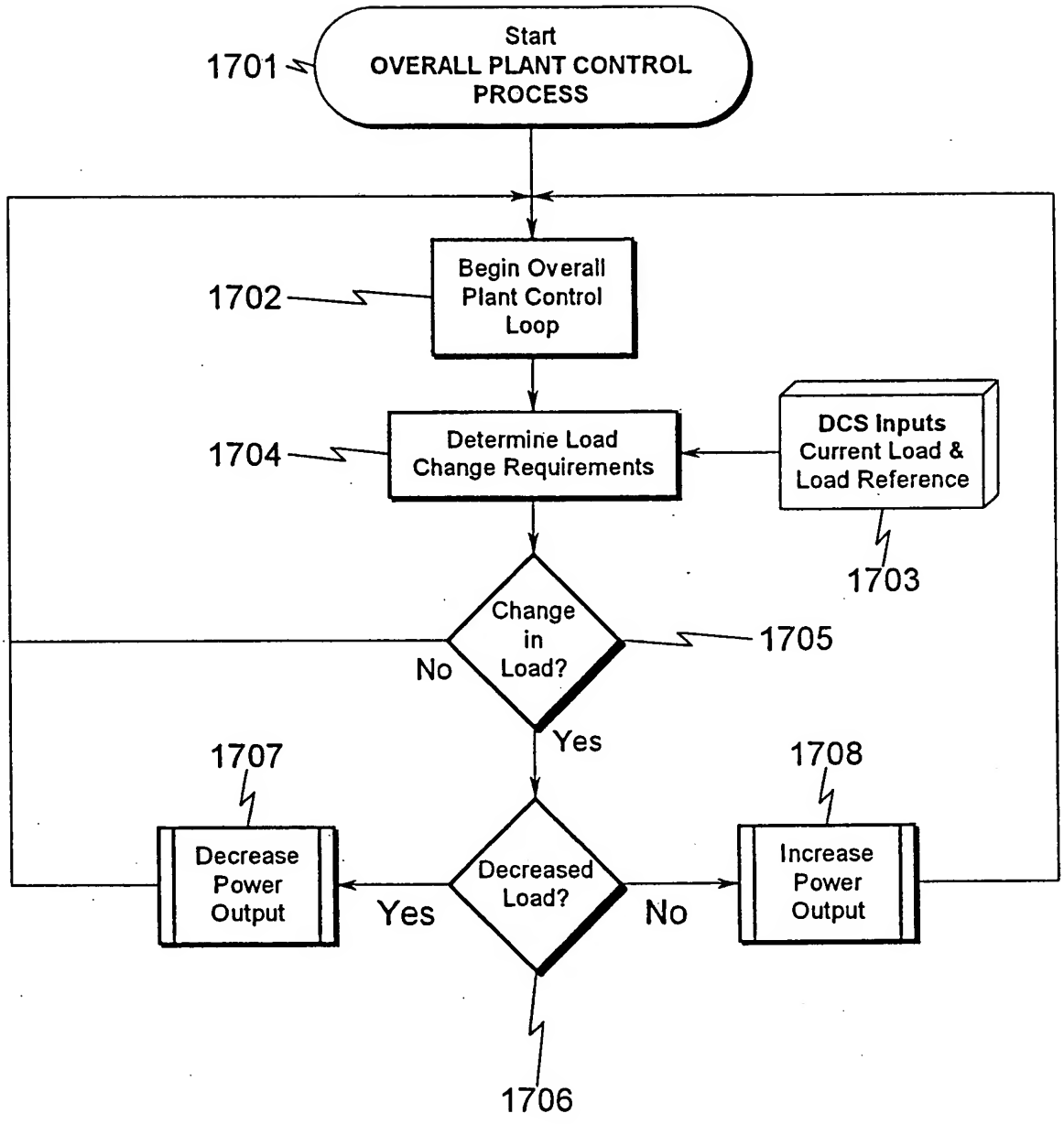

Start
OVERALL PLANT CONTROL PROCESS
1701
Begin Overall Plant Control Loop
1702
Determine Load Change Requirements
1704
DCS Inputs Current Load & Load Reference
1703
Change in Load?
1705
No
Yes
1707
1708
Decrease Power Output
Decreased Load?
Increase Power Output
Yes
No
1706

FIG. 18

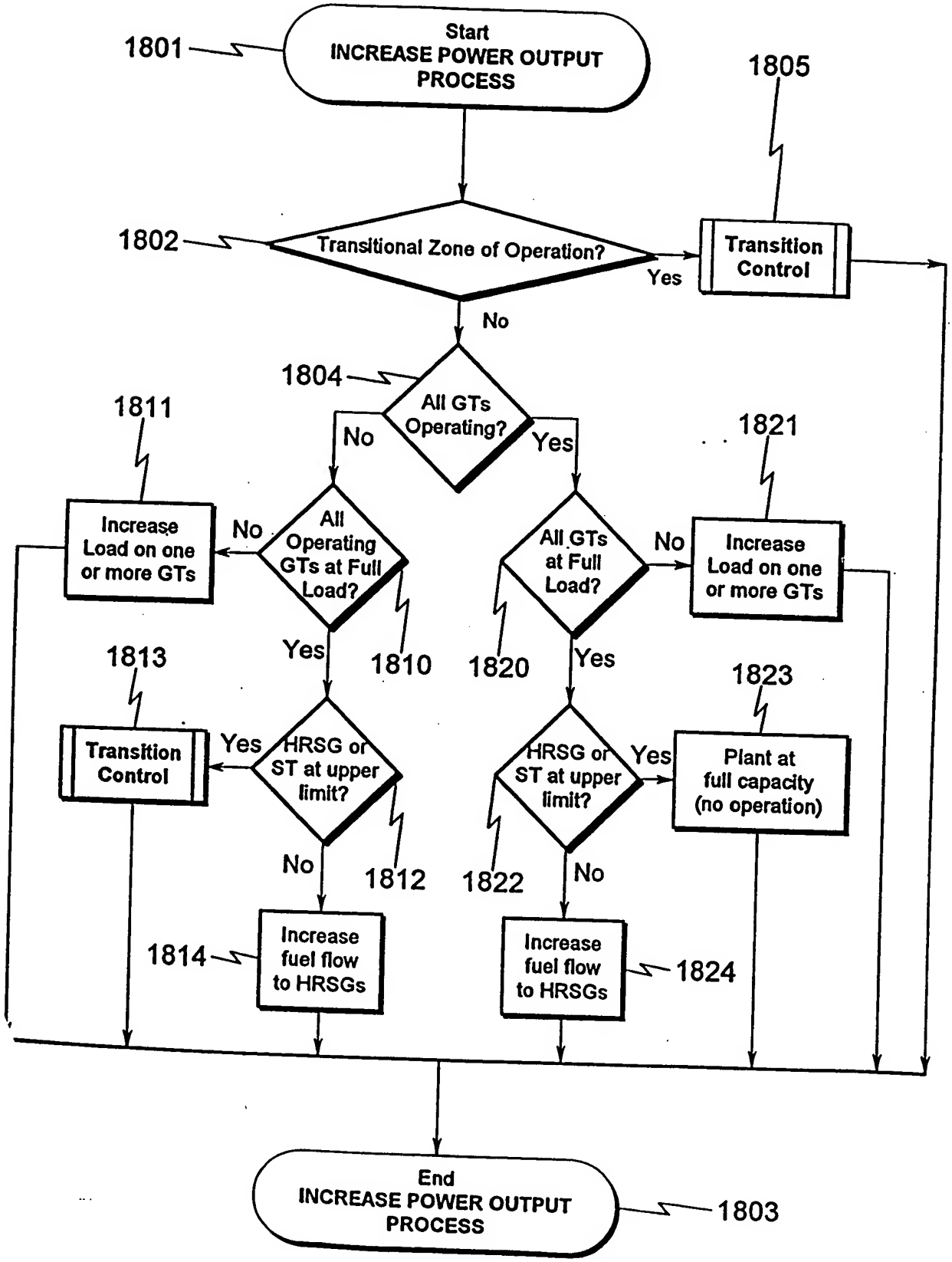

1801
Start
INCREASE POWER OUTPUT PROCESS
1805
1802
Transitional Zone of Operation?
Yes
Transition Control
No
1804
All GTs Operating?
No
Yes
1811
1821
Increase Load on one or more GTs
No
All Operating GTs at Full Load?
All GTs at Full Load?
No
Increase Load on one or more GTs
Yes
1810
1820
Yes
1813
1823
Transition Control
Yes
HRSG or ST at upper limit?
HRSG or ST at upper limit?
Yes
Plant at full capacity (no operation)
No
1812
1822
No
1814
Increase fuel flow to HRSGs
Increase fuel flow to HRSGs
1824
End
INCREASE POWER OUTPUT PROCESS
1803

FIG. 19

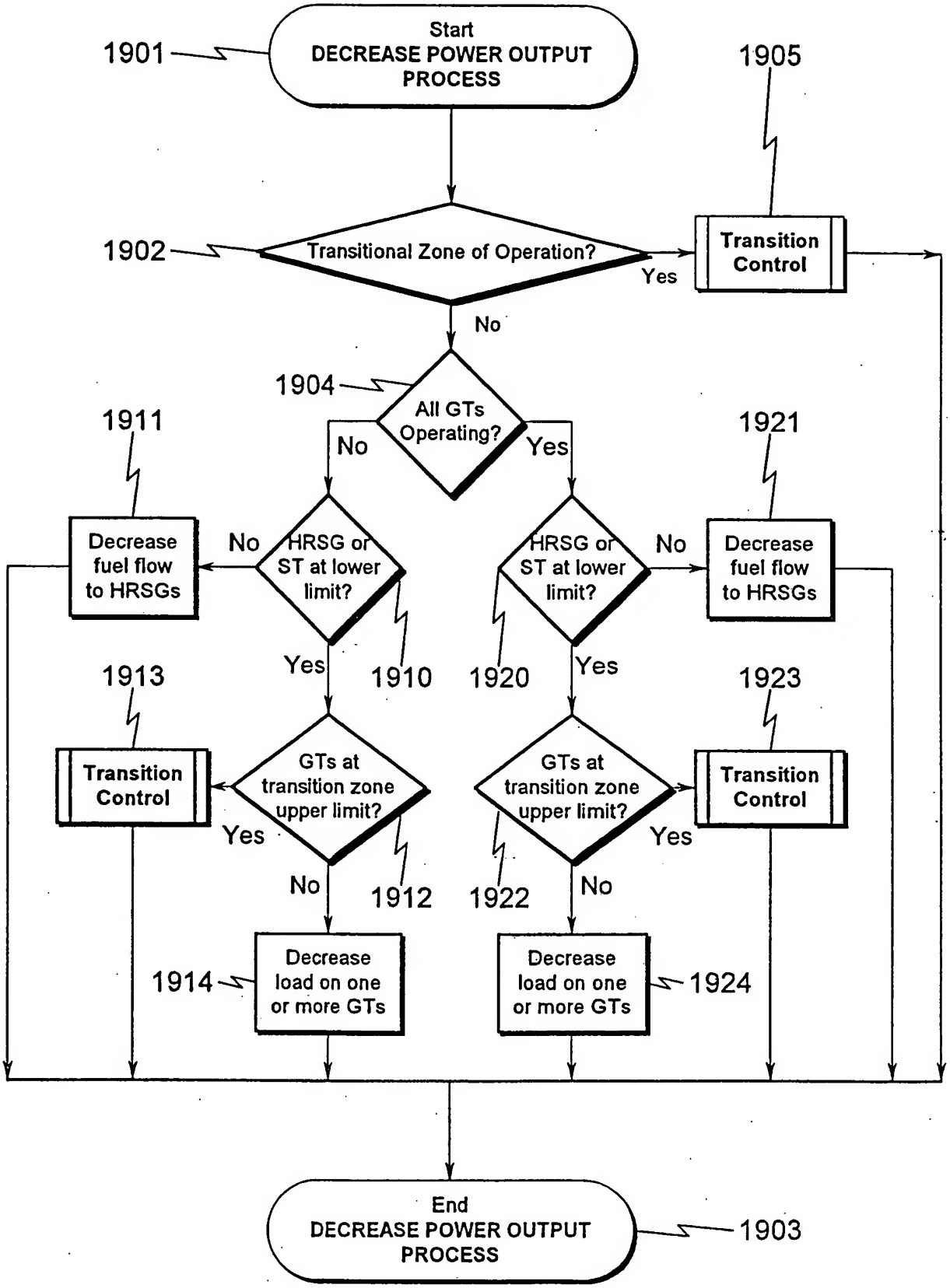
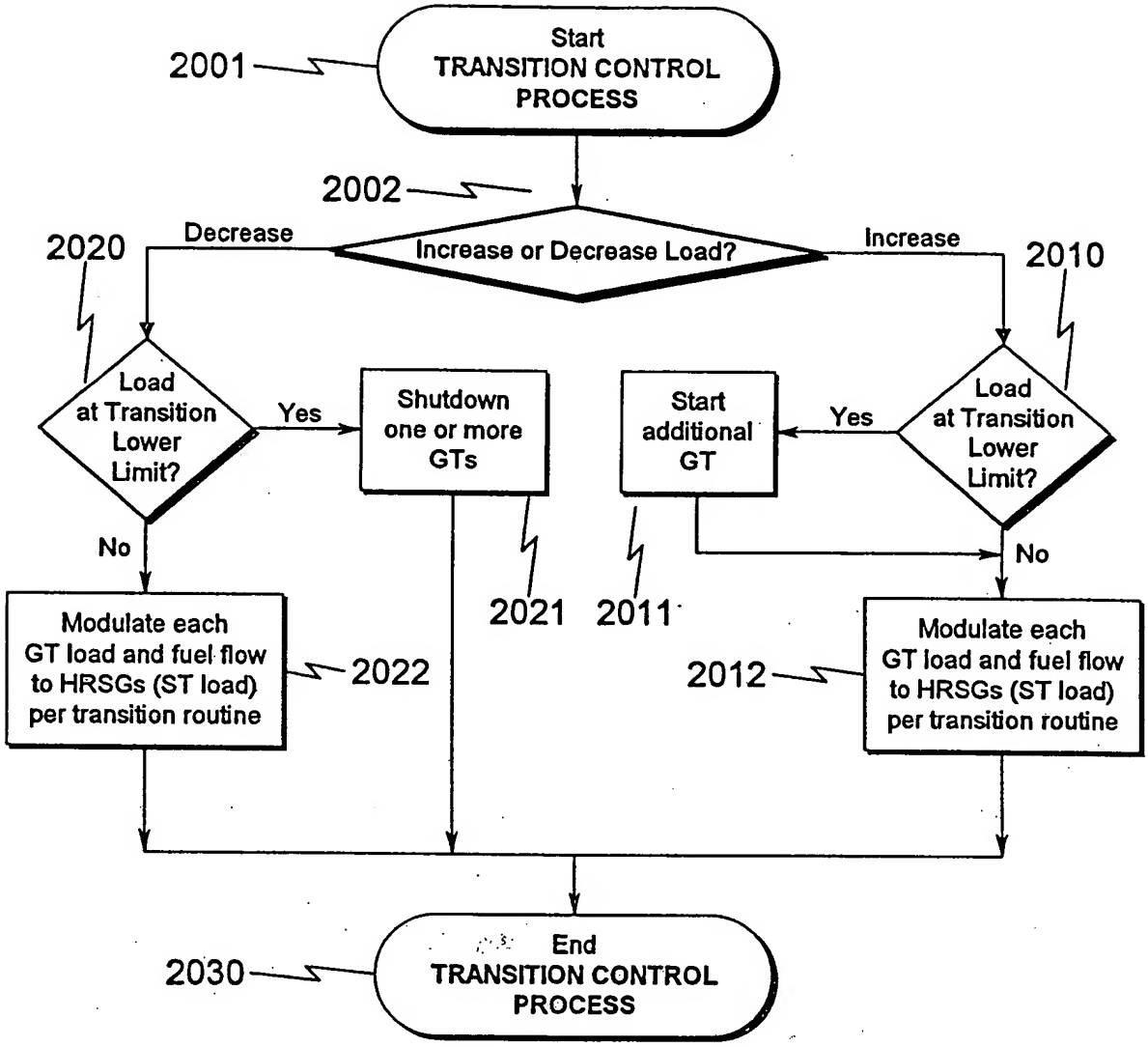

Start
DECREASE POWER OUTPUT PROCESS
1901
1905
Transitional Zone of Operation?
1902
Yes
Transition Control
No
1904
All GTs Operating?
No
Yes
1911
1921
Decrease fuel flow to HRSGs
No
HRSG or ST at lower limit?
HRSG or ST at lower limit?
No
Decrease fuel flow to HRSGs
Yes
1910
1920
Yes
1913
1923
Transition Control
GTs at transition zone upper limit?
GTs at transition zone upper limit?
Transition Control
Yes
Yes
No
1912
1922
No
1914
Decrease load on one or more GTs
Decrease load on one or more GTs
1924
End
DECREASE POWER OUTPUT PROCESS
1903

FIG. 20


Start
TRANSITION CONTROL
PROCESS
2001
2002
Increase or Decrease Load?
Decrease
Increase
2020
2010
Load
at Transition
Lower
Limit?
Yes
Shutdown
one or more
GTs
Start
additional
GT
Yes
Load
at Transition
Lower
Limit?
No
No
2021
2011
Modulate each
GT load and fuel flow
to HRSGs (ST load)
per transition routine
2022
2012
Modulate each
GT load and fuel flow
to HRSGs (ST load)
per transition routine
End
TRANSITION CONTROL
PROCESS
2030

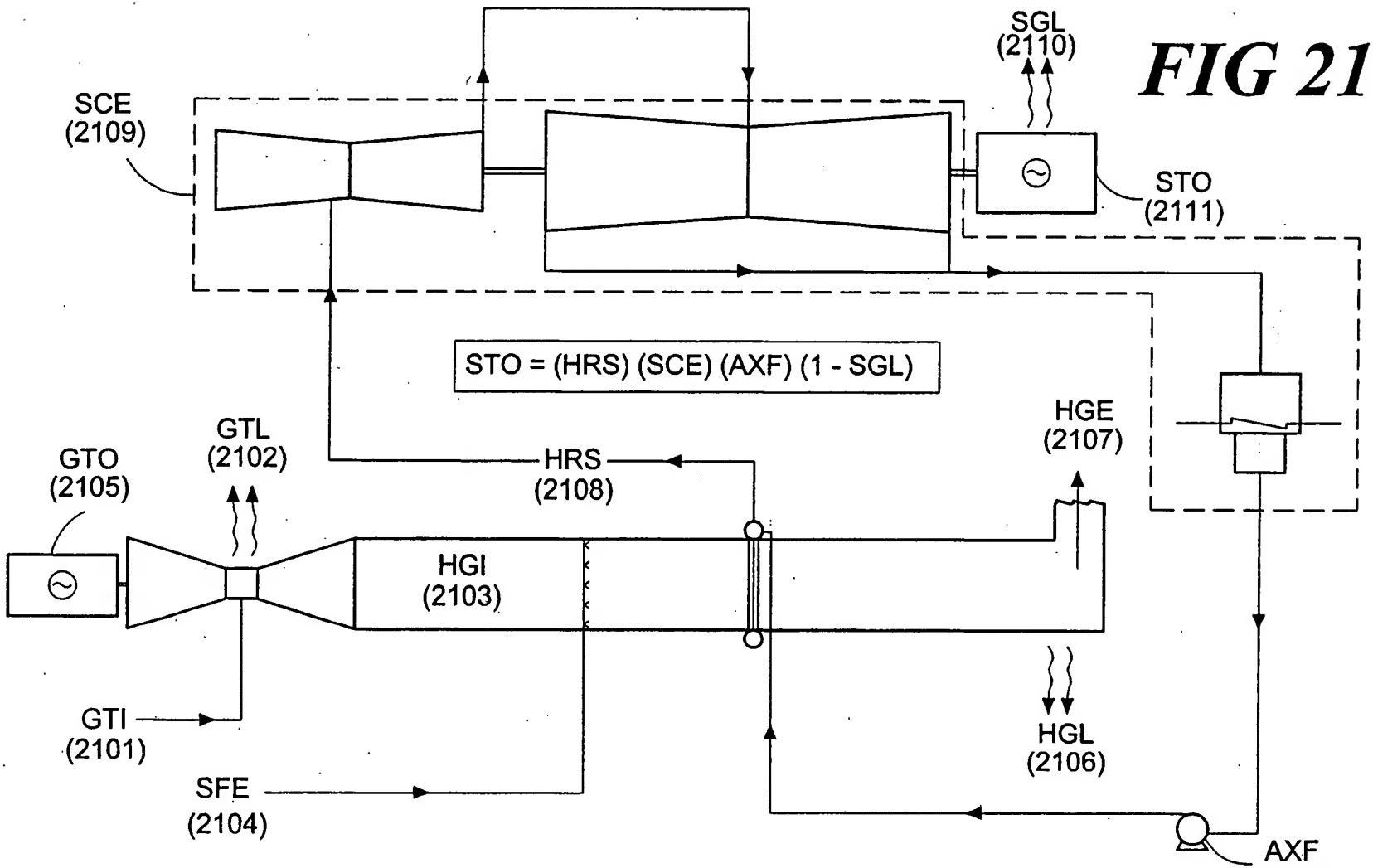
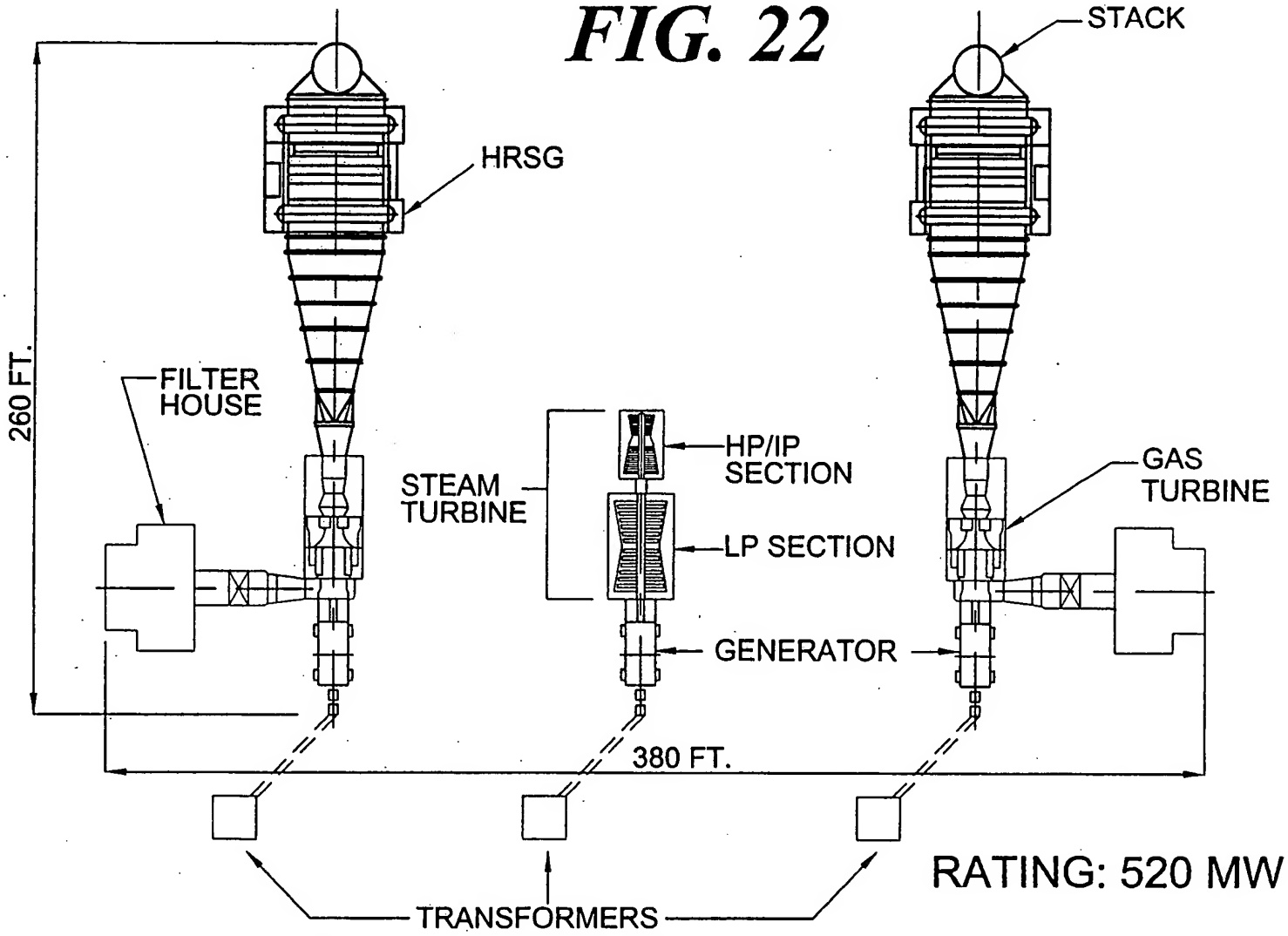


FIG 21

EXEMPLARY COMBINED CYCLE ENERGY FLOW

FIG. 22



GE S207FA COMBINED-CYCLE PLANT LAYOUT

FIG. 23A

GE S207FA Combined Cycle Power Plant
ISO Capacity – 521.6 MW

Major Equipment

Qty	Equipment	MW	Total MW
2	GE Model 7241 FA Gas Turbines	168.8	337.6
1	GE 1800 psig steam turbine	190.0	190.0
2	HRSGs, three pressure levels		
1	Auxiliary equipment (BFPs, circulation pumps, etc.)	-6.0	-6.0
	Net Plant Output	**521.6**	MW

Plant Operation Profile

Hours per Week @ Peak Power	20
Peak Power Heat Rate Correction	1.00
% of Peak Power	1.00
Hours per Week @ Intermediate Power Level	71
Intermediate Power Heat Rate Correction	1.02
% of Peak Power	0.80
Hours per Week @ Night Power Level	77
Night Power Heat Rate Correction	1.19
% of Peak Power	0.60

Plant Performance

Plant heat rate at full load	6040	BTU/kWh LHV
Natural gas fuel ratio HHV/LLV	1.11	
Plant Capacity Factor	73.21	%
Heat Rate Correction Factor for Off Peak Operation	1.0806	
Plant Availability	8500	hours/yr
Average Natural Gas Cost	$3.00	per MMBTU
Annual Electric Production	**3,246,028,571**	kWh
Annual Fuel Consumption	23,516,781	MMBTU
Annual Fuel Cost	**$70,550,343**	

FIG. 23B

GE S207FA Combined Cycle Power Plant
ISO Capacity – 521.6 MW

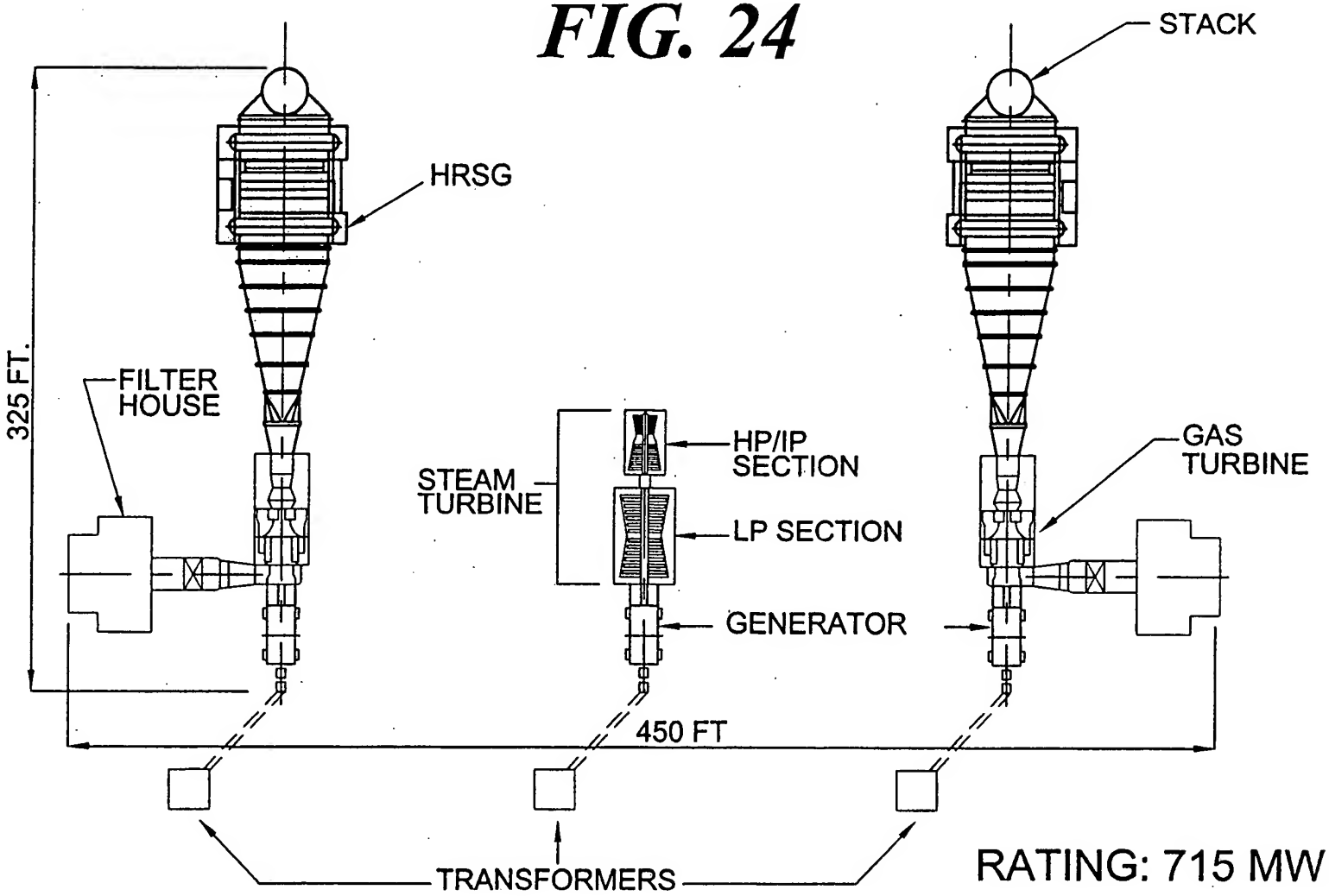
Plant Capital Costs		
Average Installed Cost	$425	$/kW
Total Plant Cost	**$221,680,000**	
Interest Rate	8.00%	
Finance Period	20	years
Annual Loan Payment (12 monthly installments)	**$22,250,644**	

Plant Maintenance		
GT Maintenance Cost	$0.0025	per kWh
ST Maintenance Cost	$0.0005	per kWh
Average Maintenance Cost	$0.0018	per kWh
Annual Maintenance Cost	**$5,777,143**	

Net Costs per kWh	
Fuel Cost	$0.0217
Capital Cost	$0.0069
Maintenance Cost	$0.0018
Total Fuel, Capital, and Maintenance Costs	**$0.0304**

NOx Emissions		
Peak Power Exhaust Flow per Gas Turbine	3,542,000	lb/hr
Peak Power NOx Levels	9	ppm
Peak Power Exhaust Flow	100.00%	
Intermediate Power NOx Levels	9	ppm
Intermediate Power Exhaust Flow	85.00%	
Night Power NOx Levels	9	ppm
Night Power Exhaust Flow	73.00%	
Expected Emissions (No aftertreatment)	352.41	tons/yr
Expected Emissions (90% Efficient SCR)	**35.24**	tons/yr

FIG. 24



WESTINGHOUSE 2X1 501G COMBINED-CYCLE PLANT

FIG. 25A

Westinghouse 2X1 501G Combined Cycle Power Plant
ISO Capacity – 715.5 MW

Major Equipment			
Qty	Equipment	MW	Total MW
2	Westinghouse Model 501G Gas Turbines	239.4	478.8
1	Westinghouse 1800 psig steam turbine	244.7	244.7
2	HRSGs, three pressure levels		
1	Auxiliary equipment (BFPs, circulation pumps, etc.)	-8.0	-8.0
	Net Plant Output	715.5	MW

Plant Operation Profile	
Hours per Week @ Peak Power	20
Peak Power Heat Rate Correction	1.00
% of Peak Power	1.00
Hours per Week @ Intermediate Power Level	71
Intermediate Power Heat Rate Correction	1.02
% of Peak Power	0.80
Hours per Week @ Night Power Level	77
Night Power Heat Rate Correction	1.19
% of Peak Power	0.60

Plant Performance		
Plant heat rate at full load	5830	BTU/kWh LHV
Natural gas fuel ratio HHV/LLV	1.11	
Plant Capacity Factor	73.21	%
Heat Rate Correction Factor for Off Peak Operation	1.0806	
Plant Availability	8500	hours/yr
Average Natural Gas Cost	$3.00	per MMBTU
Annual Electric Production	**4,452,709,821**	kWh
Annual Fuel Consumption	31,137,342	MMBTU
Annual Fuel Cost	$93,412,027	

FIG. 25B

Westinghouse 2X1 501G Combined Cycle Power Plant
ISO Capacity – 715.5 MW

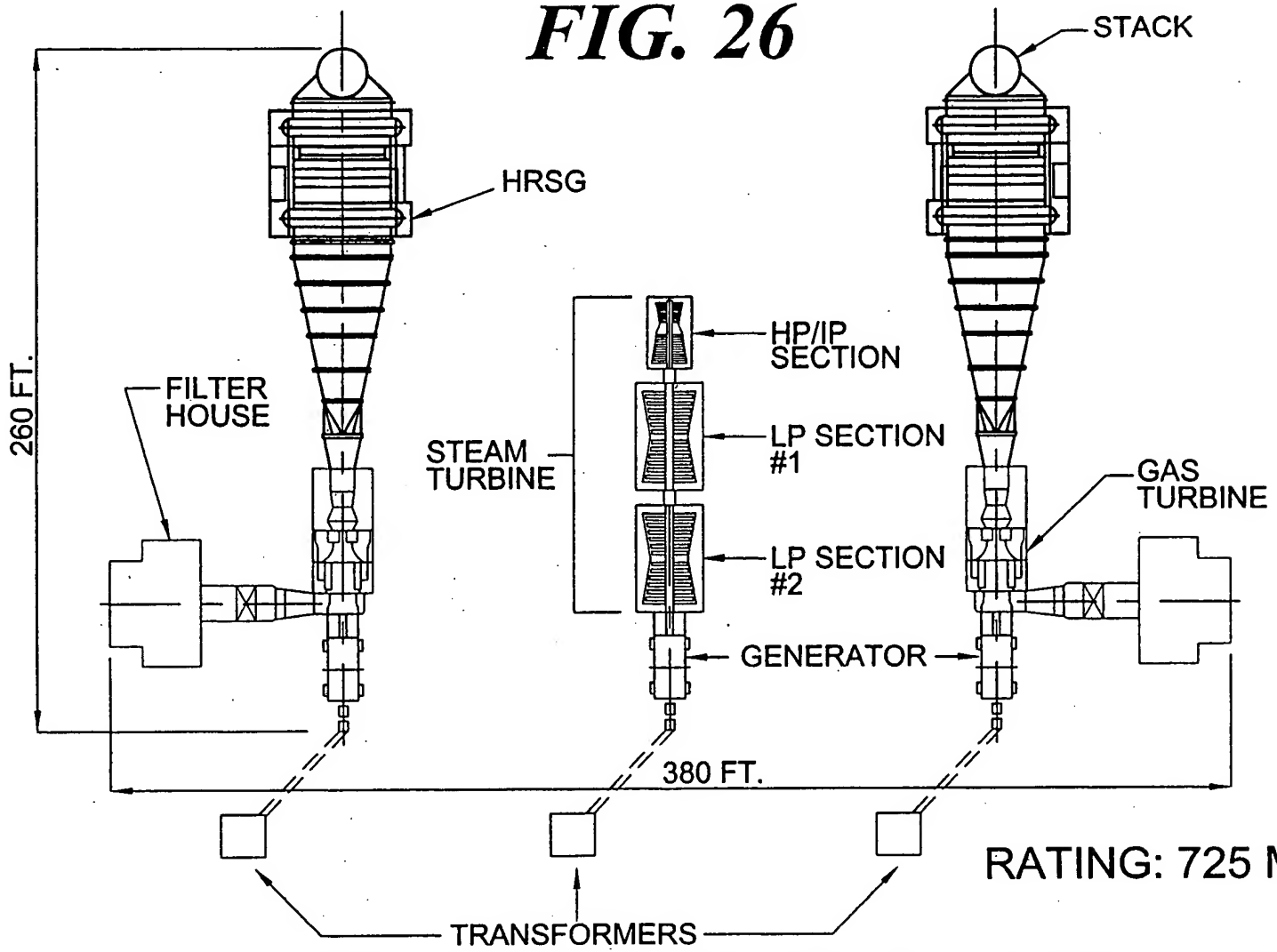
Plant Capital Costs		
Average Installed Cost	$475	$/kW
Total Plant Cost	**$339,862,500**	
Interest Rate	8.00%	
Finance Period	20	years
Annual Loan Payment (12 monthly installments)	**$34,112,954**	

Plant Maintenance		
GT Maintenance Cost	$0.0045	per kWh
ST Maintenance Cost	$0.0005	per kWh
Average Maintenance Cost	$0.0031	per kWh
Annual Maintenance Cost	**$14,013,266**	

Net Costs per kWh	
Fuel Cost	$0.0210
Capital Cost	$0.0077
Maintenance Cost	$0.0031
Total Fuel, Capital, and Maintenance Costs	**$0.0318**

NOx Emissions		
Peak Power Exhaust Flow per Gas Turbine	4,365,000	lb/hr
Peak Power NOx Levels	42	ppm
Peak Power Exhaust Flow	100.00%	
Intermediate Power NOx Levels	50	ppm
Intermediate Power Exhaust Flow	85.00%	
Night Power NOx Levels	60	ppm
Night Power Exhaust Flow	73.00%	
Expected Emissions (No aftertreatment)	2554.81	tons/yr
Expected Emissions (90% Efficient SCR)	**255.48**	tons/yr

FIG. 26



PREFERRED EMBODIMENT 725 MW COMBINED CYCLE

FIG. 27A

Exemplary Preferred Embodiment Combined Cycle Power Plant ISO Capacity – 725 MW

Major Equipment			
Qty	Equipment	MW	Total MW
2	GE Model 7241 FA Gas Turbines	168.8	337.6
1	GE 2400 psig steam turbine	395.9	395.9
2	HRSGs, three pressure levels		
1	Auxiliary equipment (BFPs, circulation pumps, etc.)	-8.5	-8.5
	Net Plant Output	725	MW

Plant Operation Profile	
Hours per Week @ Peak Power	20
Peak Power Heat Rate Correction	1.00
% of Peak Power	1.00
Hours per Week @ Intermediate Power Level	71
Intermediate Power Heat Rate Correction	1.00
% of Peak Power	0.80
Hours per Week @ Night Power Level	77
Night Power Heat Rate Correction	1.03
% of Peak Power	0.60

Plant Performance		
Plant heat rate at full load	6006	BTU/kWh LHV
Natural gas fuel ratio HHV/LLV	1.11	
Plant Capacity Factor	73.21	%
Heat Rate Correction Factor for Off Peak Operation	1.0095	
Plant Availability	8500	hours/yr
Average Natural Gas Cost	$3.00	per MMBTU
Annual Electric Production	**4,511,830,357**	kWh
Annual Fuel Consumption	30,365,273	MMBTU
Annual Fuel Cost	$91,095,818	

FIG. 27B

Exemplary Preferred Embodiment Combined Cycle Power Plant
ISO Capacity – 725 MW

Plant Capital Costs		
Average Installed Cost	$330	$/kW
Total Plant Cost	**$239,250,000**	
Interest Rate	8.00%	
Finance Period	20	years
Annual Loan Payment (12 monthly installments)	**$24,014,194**	

Plant Maintenance		
GT Maintenance Cost	$0.0025	per kWh
ST Maintenance Cost	$0.0005	per kWh
Average Maintenance Cost	$0.0011	per kWh
Annual Maintenance Cost	**$4,737,422**	

Net Costs per kWh	
Fuel Cost	$0.0202
Capital Cost	$0.0053
Maintenance Cost	$0.0011
Total Fuel, Capital, and Maintenance Costs	**$0.0266**

NOx Emissions		
Peak Power Exhaust Flow per Gas Turbine	3,542,000	lb/hr
Peak Power NOx Levels	20.9	ppm
Peak Power Exhaust Flow	100.76%	
Intermediate Power NOx Levels	15.29	ppm
Intermediate Power Exhaust Flow	92.87%	
Night Power NOx Levels	31.26	ppm
Night Power Exhaust Flow	50.72%	
Expected Emissions (No aftertreatment)	759.90	tons/yr
Expected Emissions (90% Efficient SCR)	**75.99**	tons/yr

FIG 28

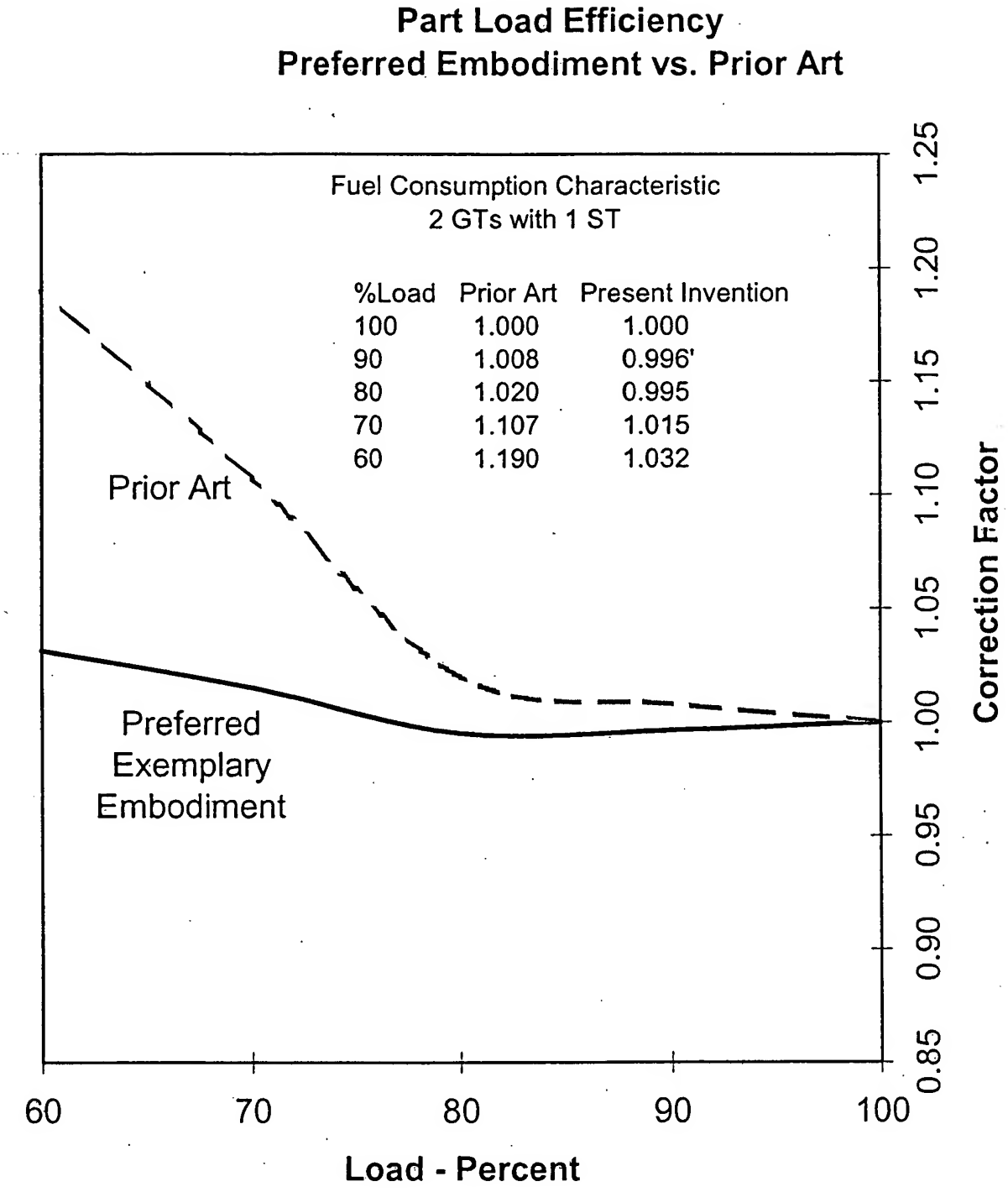

Part Load Efficiency
Preferred Embodiment vs. Prior Art
Fuel Consumption Characteristic
2 GTs with 1 ST
%Load Prior Art Present Invention
100 1.000 1.000
90 1.008 0.996'
80 1.020 0.995
70 1.107 1.015
60 1.190 1.032
Prior Art
Preferred
Exemplary
Embodiment
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
Correction Factor
60
70
80
90
100
Load - Percent

FIG. 29

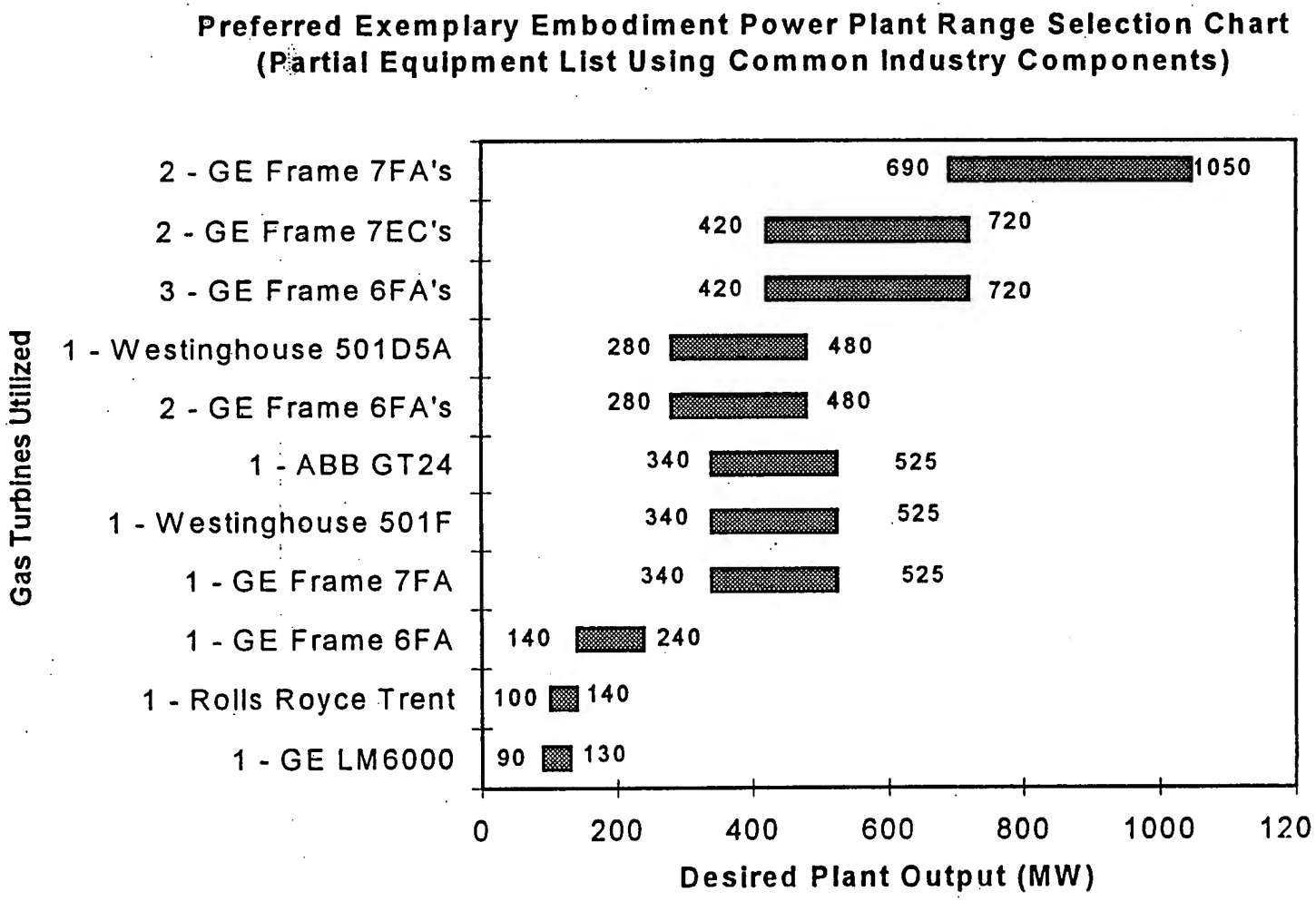

Preferred Exemplary Embodiment Power Plant Range Selection Chart
(Partial Equipment List Using Common Industry Components)
Gas Turbines Utilized
2 - GE Frame 7FA's
2 - GE Frame 7EC's
3 - GE Frame 6FA's
1 - Westinghouse 501D5A
2 - GE Frame 6FA's
1 - ABB GT24
1 - Westinghouse 501F
1 - GE Frame 7FA
1 - GE Frame 6FA
1 - Rolls Royce Trent
1 - GE LM6000
690
1050
420
720
420
720
280
480
280
480
340
525
340
525
340
525
140
240
100
140
90
130
0
200
400
600
800
1000
120
Desired Plant Output (MW)

FIG. 30

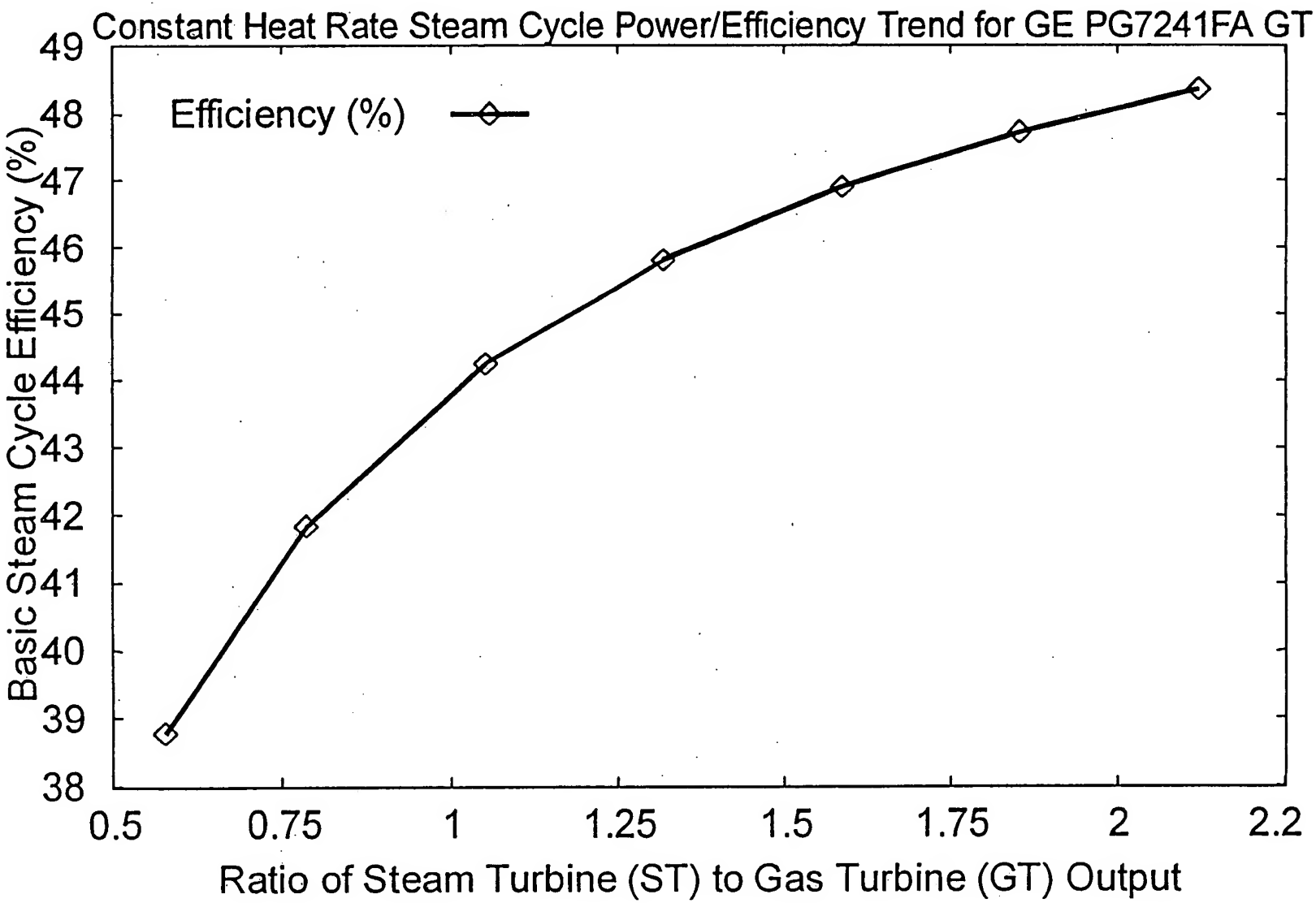

Constant Heat Rate Steam Cycle Power/Efficiency Trend for GE PG7241FA GT
Efficiency (%)
Basic Steam Cycle Efficiency (%)
49
48
47
46
45
44
43
42
41
40
39
38
0.5
0.75
1
1.25
1.5
1.75
2
2.2
Ratio of Steam Turbine (ST) to Gas Turbine (GT) Output

FIG. 31A

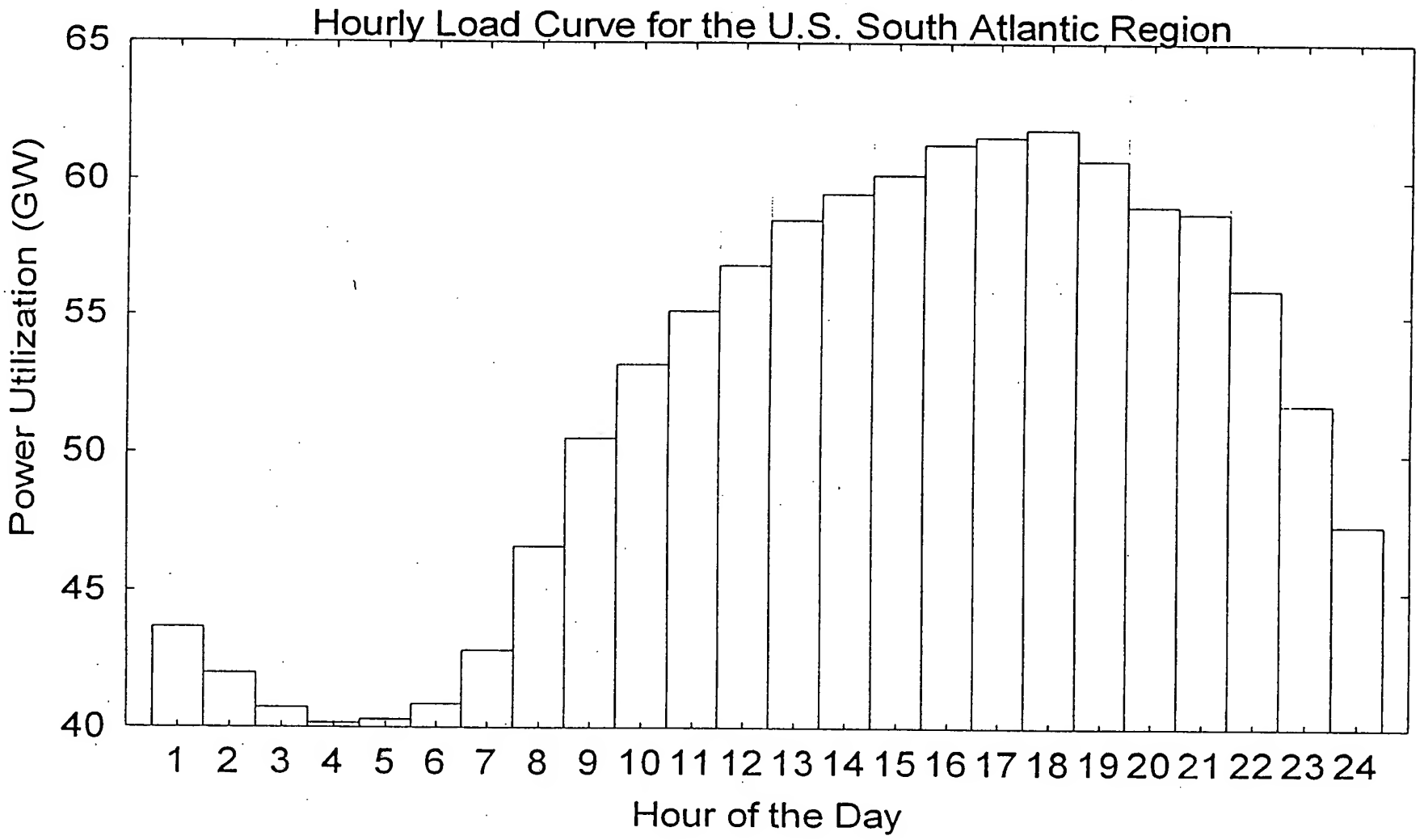

Hourly Load Curve for the U.S. South Atlantic Region
Power Utilization (GW)
65
60
55
50
45
40
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour of the Day

FIG. 31B

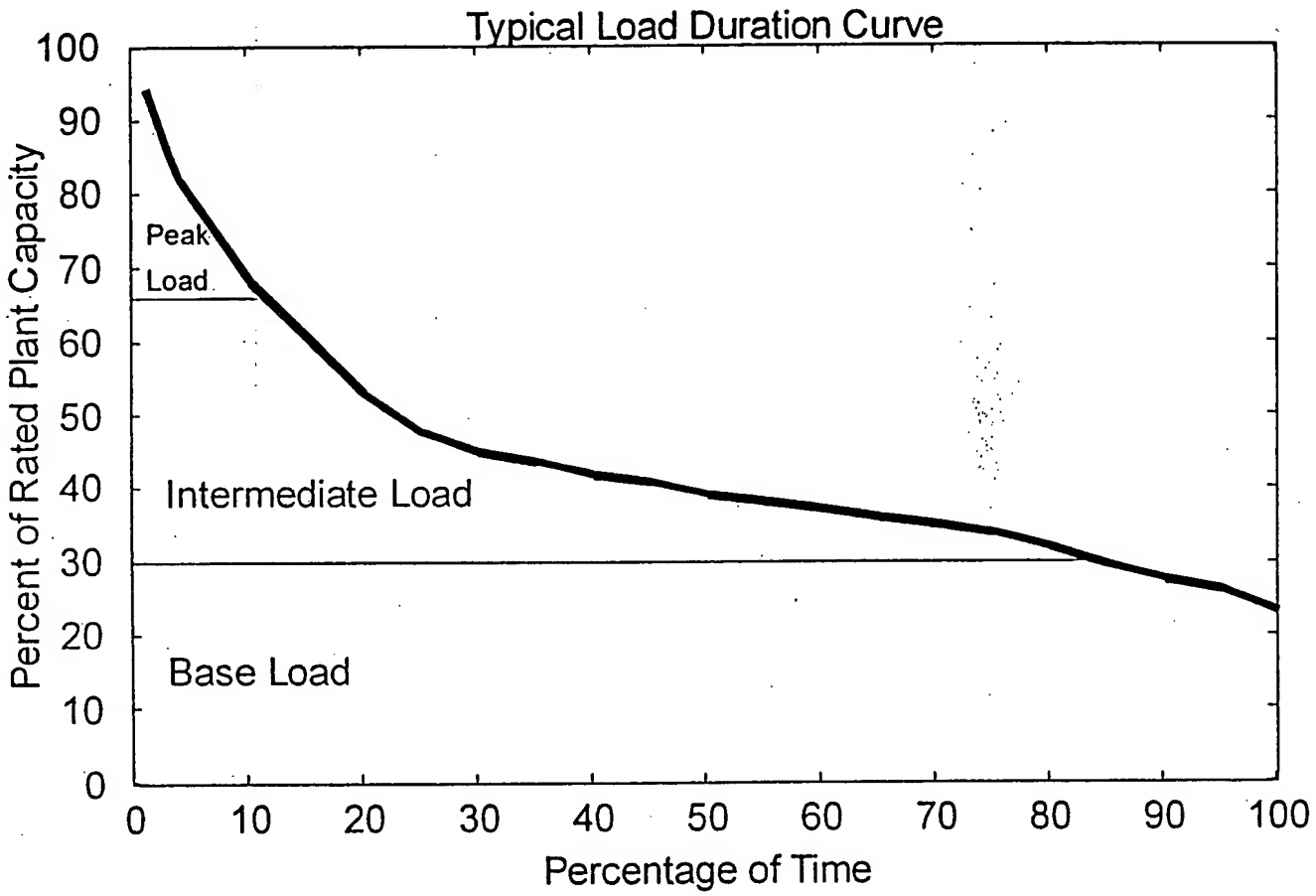

Typical Load Duration Curve
Percent of Rated Plant Capacity
100
90
80
70
60
50
40
30
20
10
0
Peak
Load
Intermediate Load
Base Load
0
10
20
30
40
50
60
70
80
90
100
Percentage of Time

FIG. 32

Typical Load Profile
(Based upon DOE Information from FIG. 31A)

System Capacity 70 GW

Weekday Profile		
Hour	Period	GW
1	Night	43
2	Night	42
3	Night	41
4	Night	40
5	Night	40
6	Night	41
7	Night	42
8	Night	47
		336
9	Intermediate	51
10	Intermediate	53
11	Intermediate	55
12	Intermediate	57
13	Intermediate	59
14	Intermediate	60
15	Intermediate	60
		395
16	Peak	61
17	Peak	62
18	Peak	62
19	Peak	61
		246
20	Intermediate	59
21	Intermediate	58
22	Intermediate	56
23	Intermediate	52
		225
24	Night	48

Weekend Profile
8 hours/day @ Intermediate Power Level
16 hours/day @ Night Power Level

Weekday Totals			
Period	Average GW	Average % Capacity	Weekday Hours
Night	42.67	60.95%	45
Intermediate	56.36	80.52%	55
Peak	61.50	87.86%	20
Overall	52.08	74.40%	120

Weekend Totals			
Period	Average GW	Average % Capacity	Weekend Hours
Night	42.67	60.95%	32
Intermediate	56.36	80.52%	16
Peak	0.00	0.00%	0
Overall	47.23	67.47%	48

Totals for Entire Week			
Period	Average GW	Average % Capacity	Hours
Night	42.67	60.95%	77
Intermediate	56.36	80.52%	71
Peak	61.50	87.86%	20
Overall	50.70	72.42%	168

FIG. 33

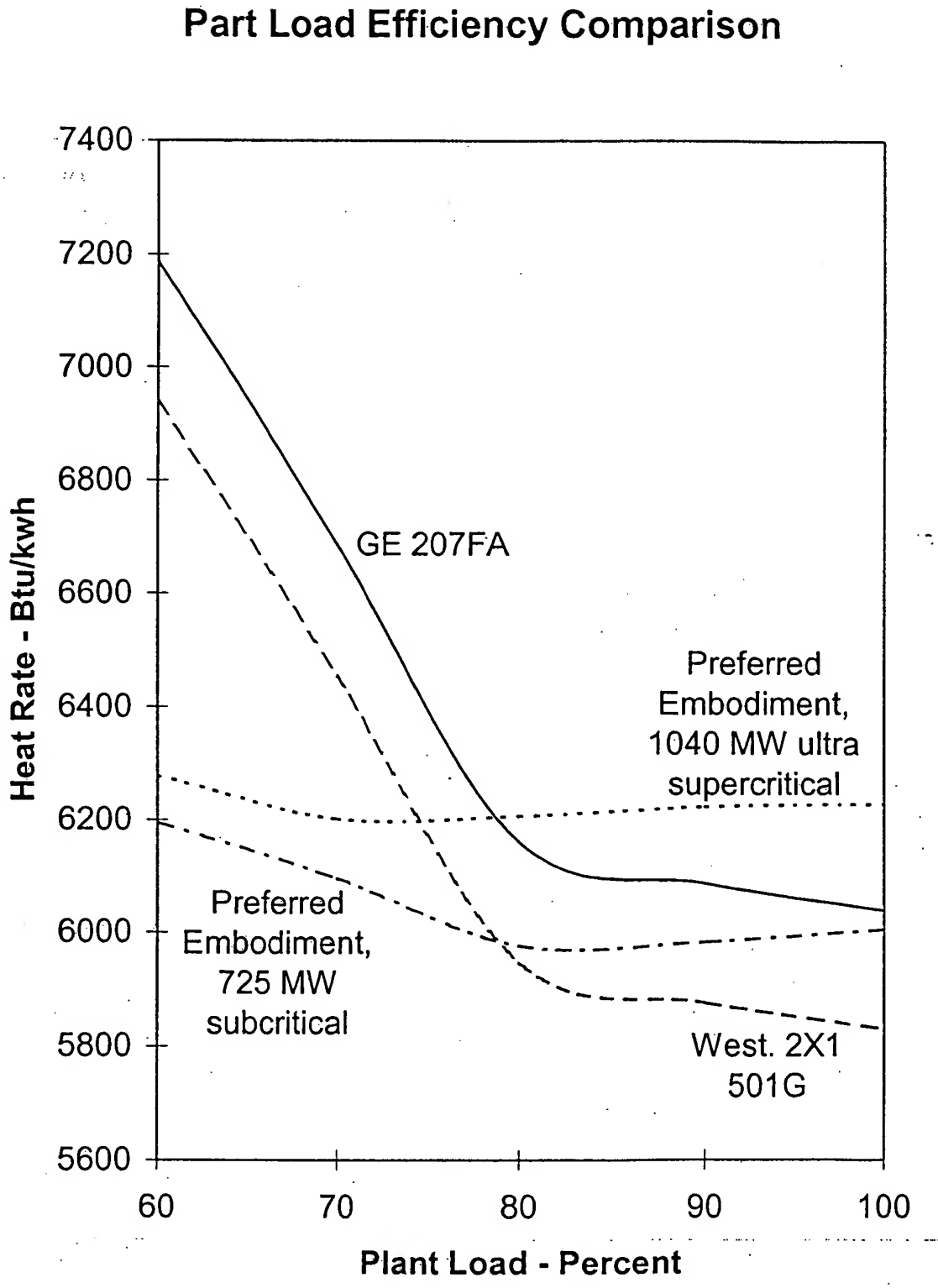

Part Load Efficiency Comparison
7400
7200
7000
6800
6600
6400
6200
6000
5800
5600
Heat Rate - Btu/kwh
GE 207FA
Preferred Embodiment, 1040 MW ultra supercritical
Preferred Embodiment, 725 MW subcritical
West. 2X1 501G
60
70
80
90
100
Plant Load - Percent

FIG. 34

ECONOMIC COMPARISON									
Combined Cycle Plant	**GT Technology**	**Fuel Costs**	**Capital Costs**	**Main-tenance Costs**	**Total Major Costs**	**Net Electricity Produced**	**Average Cost Per kWh**	**NOX Emissions**	**Specific NOX Emissions**
		MM US$	MM US$	MM US$	MM US$	MM kWh	US$/ kWh	tons	tons/ MM kWh
General Electric GE S207FA (520 MW)	GE "F" Technology	70.55	22.25	5.78	98.58	3,246	0.0304	35.24	0.0109
725 MW Invention Embodiment	GE "F" Technology	91.10	24.01	4.74	119.85	4,512	0.0266	75.99	0.0168
	Net Cost Savings:						**0.0038**		
	Annual Savings:	**$12.35**							
	20 Year Savings:	**$247.08**							
Westinghouse W 2X1 501G (715 MW)	W "G" Technology	93.41	34.11	14.01	141.54	4,453	0.0318	255.48	0.0574
725 MW Invention Embodiment	GE "F" Technology	91.10	24.01	4.74	119.85	4,512	0.0266	75.99	0.0168
	Net Cost Savings:						**0.0052**		
	Annual Savings:	**$23.26**							
	20 Year Savings:	**$465.22**							

NOTES: (1) Fuel costs at $3.00 per MM BTU
(2) Load profile from 60 to 100% utilizing a trend typical for current electrical usage
(3) Capital costs assume a 100% loan at 8% interest for 20 years
(4) Total costs include fuel, capital, and maintenance costs

FIG 35

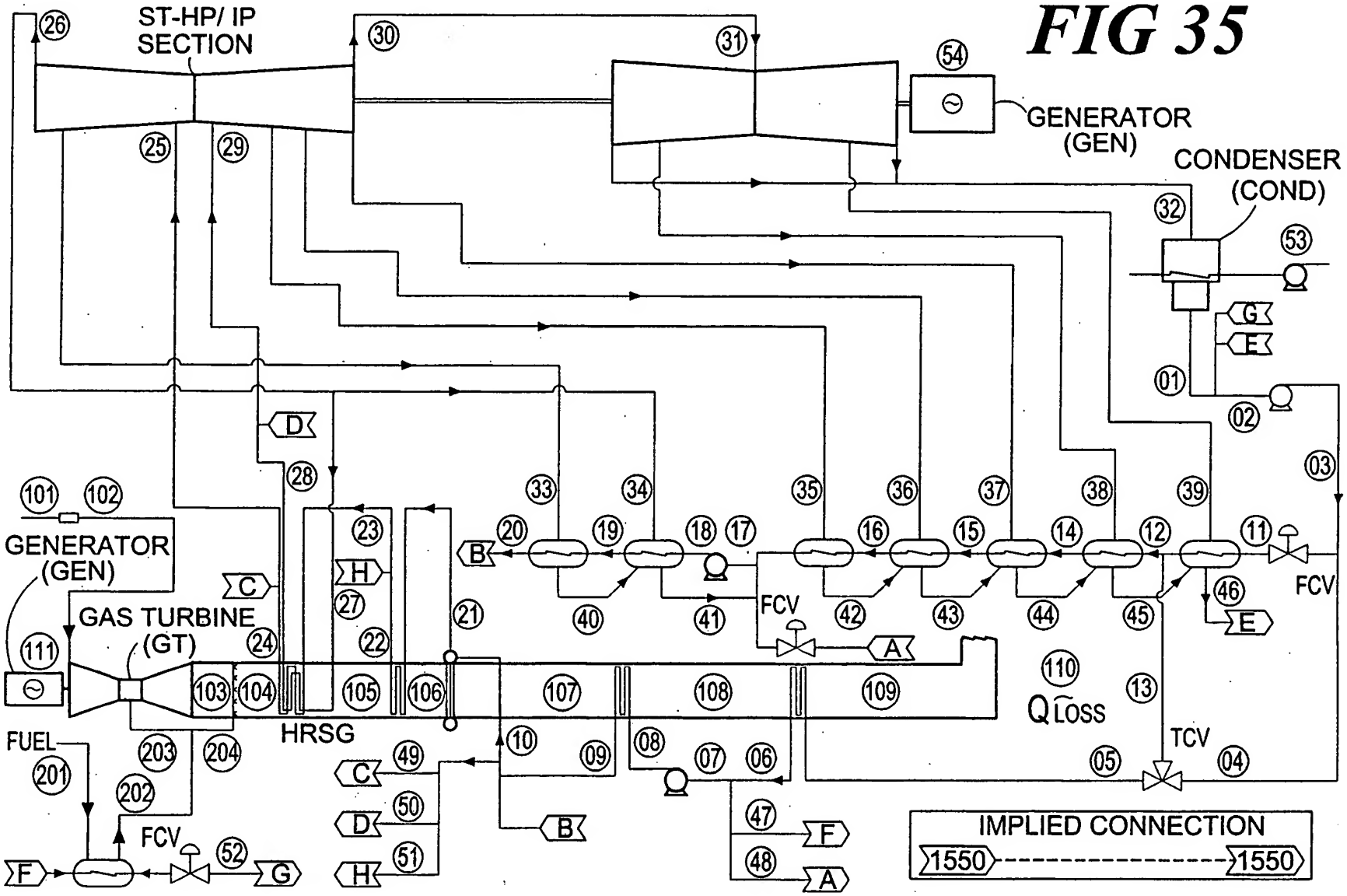

ST-HP/ IP SECTION
GENERATOR (GEN)
CONDENSER (COND)
GENERATOR (GEN)
GAS TURBINE (GT)
HRSG
FUEL
FCV
TCV
Q LOSS
IMPLIED CONNECTION
1550
1550

FIG 36

Exemplary Preferred Embodiment Heat Balance							
725 MW Combined Cycle with 2 - GE Frame 7 GTs, 2400 psig steam cycle							
Steam/Feedwater System							
Point	Pressure	Temp	Enthalpy	Flow	Heat Input	Power	Comments
	psia	Degrees F	BTU/lb	lb/hr	MMBTU /hr	kW	
1	0.59	84.66	52.689	1749377			
2	0.59	84.66	53.754	1956488			
3	550.00	86.29	55.793	1956488		-1169	Pump power, point 2 - 3
4	539.00	86.29	55.793	994750			
5	539.00	119.18	88.521	1775863			Preheat feedwater to dew point of exhaust gases
6	528.22	386.06	360.471	1775863			
7	528.22	386.06	360.471	1366048			
8	3002.96	391.62	369.655	1366048		-3676	Pump power, point 7 - 8
9	2913.55	689.56	780.423	1366048			
10	2913.55	664.61	713.255	1776869			
11	550.00	86.29	55.793	961739			
12	539.00	160.93	130.200	180625			
13	550.00	160.93	130.200	781113			Feedwater - Exit FWH 1
14	528.22	229.41	198.872	180625			Feedwater - Exit FWH 2
15	517.66	298.23	268.796	180625			Feedwater - Exit FWH 3
16	507.30	355.21	327.796	180625			Feedwater - Exit FWH 4
17	497.16	408.59	384.714	180625			Feedwater - Exit FWH 5
18	3002.96	404.80	383.553	599668		-1634	Pump power, point 17 - 18
19	2957.92	496.07	483.061	599668			Feedwater - Exit FWH 6
20	2913.55	561.37	560.245	599668			Feedwater - Exit FWH 7
21	2767.87	690.92	1037.440	1776869			Exit Evaporator
22	2684.84	854.67	1336.605	1776869			Exit Superheater Section 1
23	2684.84	845.18	1333.204	1786620			Enter Superheater Section 2
24	2681.22	1169.43	1562.578	1786620			Exit Superheater Section 2
25	2627.59	1050.00	1486.820	1965717			ST HP Section Inlet
26	672.00	667.80	1327.813	1913817			ST HP Section Outlet
27	672.00	667.80	1327.813	1855328			Enter Reheater Section
28	618.24	1050.00	1544.119	1855328			Exit Reheater Section
29	618.24	1050.00	1544.119	1855328			ST IP Section Inlet
30	64.95	486.64	1276.096	1836454			ST IP Section Outlet
31	63.65	486.37	1276.096	1825874			ST LP Section Inlet
32	0.59	84.66	973.250	1749377			ST LP Section Outlet

FIG 37

Exemplary Preferred Embodiment Heat Balance							
725 MW Combined Cycle with 2 - GE Frame 7 GTs, 2400 psig steam cycle							
Steam/Feedwater System							
Point	Pressure	Temp	Enthalpy	Flow	Heat Input	Power	Comments
	psia	Degrees F	BTU/lb	lb/hr	MMBTU /hr	kW	
33	1100.80	803.31	1386.731	51900			1st Extraction Steam to # 7 Feedwater Heater, 5% Press Drop
34	645.12	664.75	1327.813	58489			2nd Extraction Steam to # 6 Feedwater Heater, 5% Press Drop
35	243.32	801.33	1424.375	9462			3rd Extraction Steam to # 5 Feedwater Heater, 5% Press Drop
36	131.39	646.41	1350.853	9411			4th Extraction Steam to # 4 Feedwater Heater, 5% Press Drop
37	62.36	486.11	1276.096	10580			5th Extraction Steam to # 3 Feedwater Heater, 5% Press Drop
38	20.94	287.54	1185.142	9914			6th Extraction Steam to # 2 Feedwater Heater, 5% Press Drop
39	5.45	165.93	1094.921	66583			7th Extraction Steam to # 1 Feedwater Heater, 5% Press Drop
40	1100.80	506.07	494.933	51900			
41	645.12	418.59	395.673	110389			
42	243.32	365.15	337.873	9462			
43	131.39	308.23	278.313	18873			
44	62.36	239.41	207.926	29453			
45	20.94	170.93	138.940	39367			
46	5.45	96.29	64.305	105951			
47	528.22	386.06	360.471	101161			
48	528.22	386.06	360.471	308654			
49	2913.55	664.61	713.255	179097			
50	2913.55	664.61	713.255	0			
51	2913.55	664.61	713.255	9750			
52	528.22	93.33	62.807	101161			
53						-939	Pump power, cooling water
						-7418	Total Auxiliary Load
54						390878	ST Generator Output
						383460	Net Steam cycle power

FIG 38

Exemplary Preferred Embodiment Heat Balance							
725 MW Combined Cycle with 2 - GE Frame 7 GTs, 2400 psig steam cycle							
GT/HRSG System							
Point	**Pressure**	**Temp**	**Enthalpy**	**Flow**	**Heat Input**	**Power**	**Comments**
	psia	**Degrees F**	**BTU/lb**	**lb/hr**	**MMBTU /hr**	**kW**	
101	14.70	59.00		6954954			
102	14.59	59.00		6954954			
103	15.18	1123.00	412.64	7103452			
104	15.18	1650.65	573.79	7157276			
105	15.09	1267.65	459.31	7157276			
106	15.00	1002.46	384.29	7157276			
107	14.91	711.24	303.00	7157276			
108	14.82	417.83	223.80	7157276			
109	14.70	156.55	155.65	7157276			
110					-29.93		HRSG Heat Loss - 1%
111						341540	Net GT power
Fuel Gas System							
201	500.0	70.00	236.45	202322			
202	450.0	368.92	385.28	202322			
203	427.5	368.92	385.28	148498	3551.60		
204	45.0	368.92	385.28	53824	1281.87		

Totals	4833.47	725000

Heat Rate, HHV	6667
Heat Rate, LHV	6006

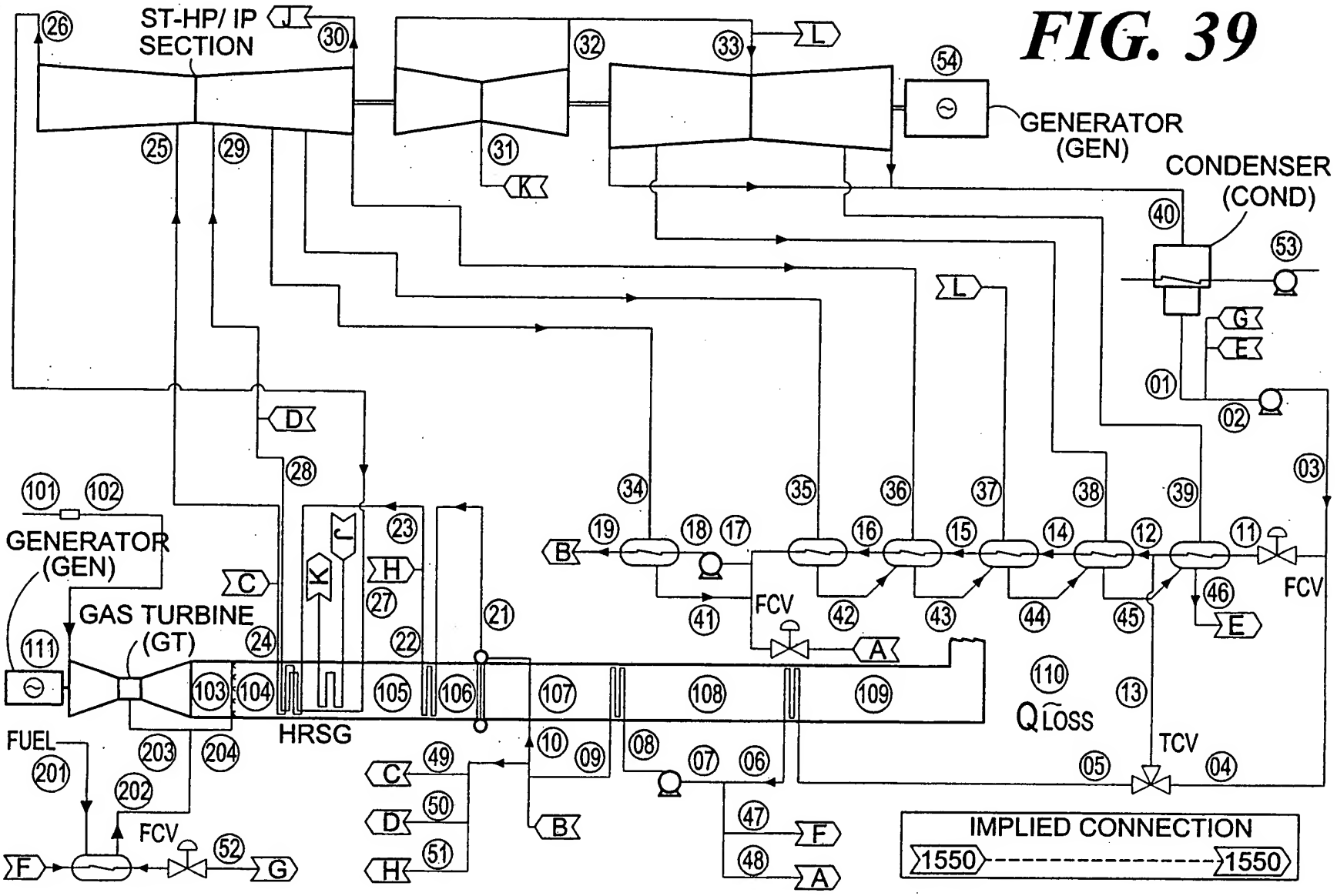

ST-HP/ IP SECTION
GENERATOR (GEN)
CONDENSER (COND)
GENERATOR (GEN)
GAS TURBINE (GT)
HRSG
FUEL
FCV
TCV
Q_{LOSS}
IMPLIED CONNECTION
1550
1550

FIG. 39

FIG 40

Exemplary Preferred Embodiment Heat Balance							
1040 MW Combined Cycle with 2 - GE Frame 7 GTs, Ultrasupercritical steam cycle							
Steam/Feedwater System							
Point	Pressure	Temp	Enthalpy	Flow	Heat Input	Power	Comments
	psia	Degrees F	BTU/lb	lb/hr	MMBTU/hr	kW	
1	0.59	84.66	52.689	2540732			
2	0.59	84.66	53.782	3153031			
3	450.00	86.21	55.450	3153031		-1541	Pump power, point 2 - 3
4	450.00	86.21	55.450	795099			
5	450.00	132.71	101.785	1775863			Preheat feedwater to dew point of exhaust gases
6	427.50	430.20	408.209	1775863			Exit Economizer 1
7	427.50	430.20	408.209	1775863			
8	4429.20	440.29	423.061	1775863		-7728	Pump power, point 7 - 8
9	4044.06	643.52	667.480	1775863			Exit Economizer 2
10	4044.06	607.00	616.610	3044712			
11	450.00	86.21	55.450	2357932			
12	450.00	170.32	139.348	1377168			Feedwater - Exit FWH 1
13	450.00	170.32	139.348	980764			To TCV
14	450.00	221.51	190.697	1377168			Feedwater - Exit FWH 2
15	450.00	297.81	268.179	1377168			Feedwater - Exit FWH 3
16	450.00	385.80	360.096	1377168			Feedwater - Exit FWH 4
17	427.50	442.21	421.528	1377168			Feedwater - Exit FWH 5
18	4429.20	455.32	439.161	1392731		-6061	Pump power, point 17 - 18
19	4429.20	496.09	483.714	1392731			Feedwater - Exit FWH 6
21	4044.06	736.63	894.294	3044712			Exit Evaporator
22	4044.06	766.46	1078.751	3044712			Exit Superheater Section 1
23	3851.48	752.42	1062.496	3155706			Enter Superheater Section 2
24	3851.48	1074.66	1466.947	3155706			Exit Superheater Section 2
25	3851.48	1070.00	1463.488	3168594			ST HP Section Inlet
26	1049.78	694.27	1318.409	3053493			ST HP Section Outlet
27	1049.78	694.27	1318.409	3053493			Enter Reheater Section 1
28	965.80	1112.00	1569.531	3053493			Exit Reheater Section 1
29	965.80	1112.00	1569.531	3053493			ST IP Section Inlet
30	218.46	698.72	1372.625	2923510			ST IP Section Outlet
31	200.98	1102.23	1583.042	2740311			ST RH2 Section Inlet
32	72.79	817.36	1439.510	2814556			ST RH2 Section Outlet

FIG 41

Exemplary Preferred Embodiment Heat Balance							
1040 MW Combined Cycle with 2 - GE Frame 7 GTs, Ultrasupercritical steam cycle							
Steam/Feedwater System							
Point	Pressure	Temp	Enthalpy	Flow	Heat Input	Power	Comments
	psia	Degrees F	BTU/lb	lb/hr	MMBTU/hr	kW	
33	66.97	816.90	1439.510	2740311			ST LP Section Inlet
34	611.58	986.16	1509.499	50957			1st Extraction Steam to # 7 Feedwater Heater, 5% Press Drop
35	370.65	843.53	1441.277	79026			2nd Extraction Steam to # 6 Feedwater Heater, 5% Press Drop
36	209.72	697.82	1372.625	108953			3rd Extraction Steam to # 5 Feedwater Heater, 5% Press Drop
37	69.88	817.13	1439.510	74245			4th Extraction Steam to # 4 Feedwater Heater, 5% Press Drop
38	19.46	452.21	1303.095	49520			5th Extraction Steam to # 3 Feedwater Heater, 5% Press Drop
39	6.76	395.80	1207.801	150060			6th Extraction Steam to # 2 Feedwater Heater, 5% Press Drop
40	0.59	84.66	1056.410	2540732			ST LP Section Outlet
41	611.58	452.21	432.802	166059			
42	370.65	395.80	370.713	79026			
43	209.72	307.81	278.021	187979			
44	69.88	231.51	199.957	262224			
45	19.46	180.32	148.348	311744			
46	6.76	96.21	64.235	461804			
47	427.50	430.20	408.227	150496			
48	427.50	430.20	408.227	0			
49	4044.06	607.00	616.610	12888			
50	4044.06	607.00	616.610	0			
51	4044.06	607.00	616.610	110994			
52	427.50	75.62	44.900	150496			
53						-1364	Pump power, cooling water
						-16694	Total Auxiliary Load
54						715154	ST Generator Output
						698460	Net Steam cycle power

FIG. 42

Exemplary Preferred Embodiment Heat Balance							
1040 MW Combined Cycle with 2 - GE Frame 7 GTs, Ultrasupercritical steam cycle							
GT/HRSG System							
Point	Pressure	Temp	Enthalpy	Flow	Heat Input	Power	Comments
	psia	Degrees F	BTU/lb	lb/hr	MMBTU/hr	kW	
101	14.70	59.00		6910726			
102	14.59	59.00		6910726			
103	15.33	1123.00	412.64	7103452			
104	15.33	2465.24	865.01	7255946			
105	15.20	1363.91	500.48	7255946			
106	15.07	1095.41	422.30	7255946			
107	14.95	689.41	304.60	7255946			
108	14.82	472.67	244.17	7255946			
109	14.70	191.95	168.42	7255946			
110					-44.73		HRSG Heat Loss - 1%
111						341540	Net GT power
Fuel Gas System							
201	500.0	50.00	227.72	300992			
202	450.0	411.70	409.38	300992			
203	427.5	411.70	409.38	300992	3546.72		
204	45.0	411.70	409.38	152494	3643.97		

Totals	7190.69	1040000

Heat Rate, HHV	6914
Heat Rate, LHV	6229

FIG. 43

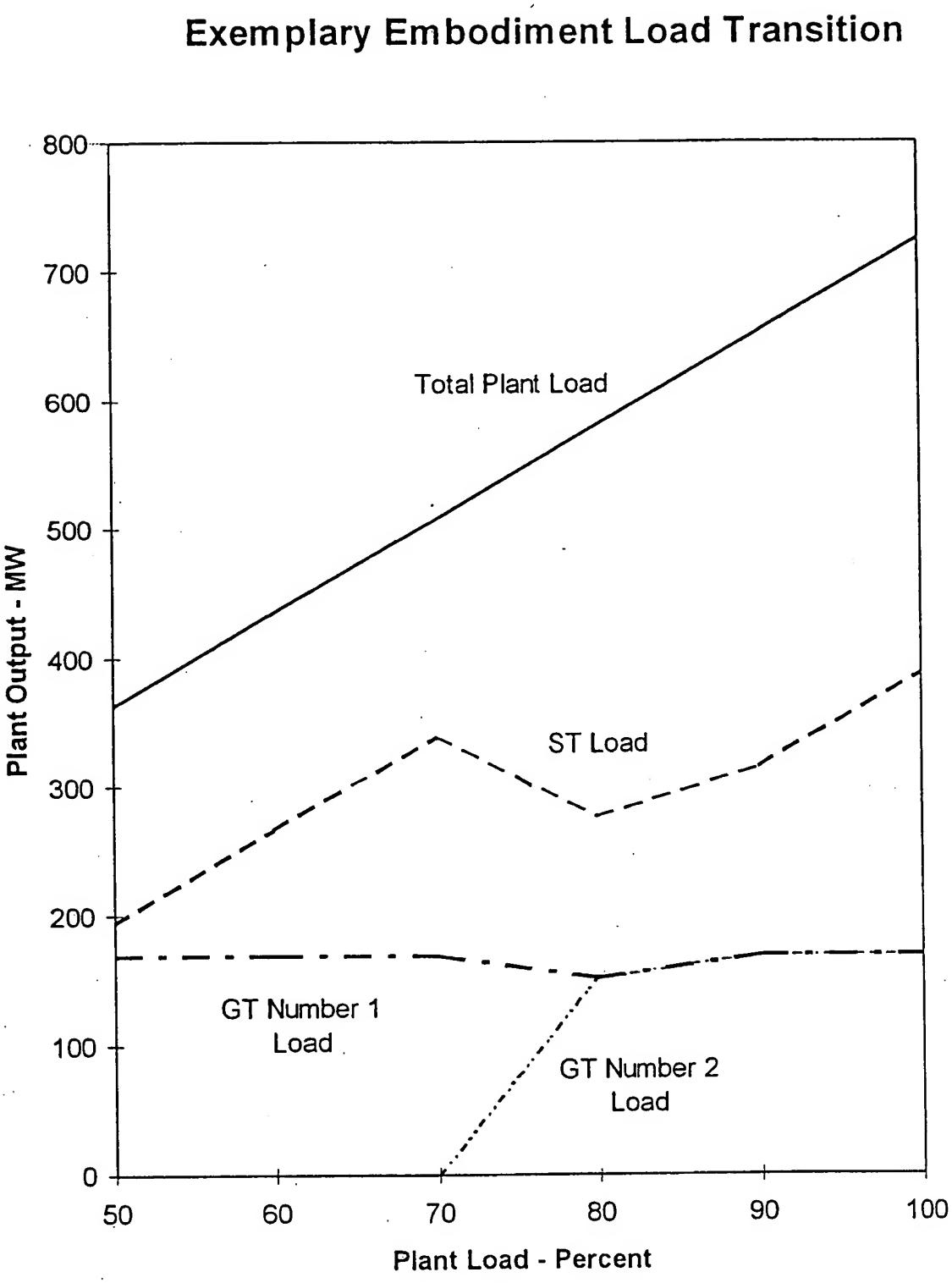

Exemplary Embodiment Load Transition
800
700
600
500
400
300
200
100
0
Plant Output - MW
Total Plant Load
ST Load
GT Number 1
Load
GT Number 2
Load
50
60
70
80
90
100
Plant Load - Percent

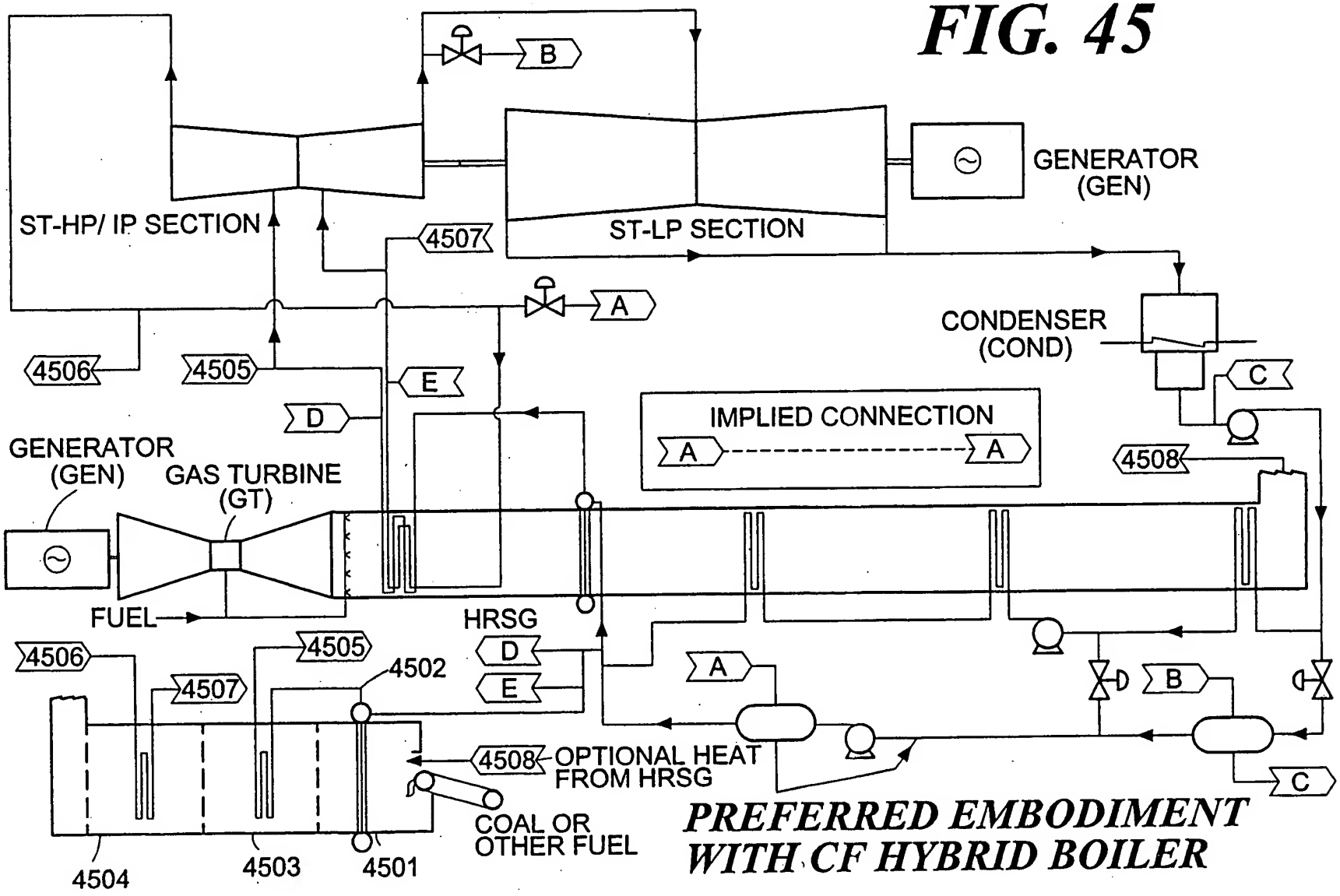
FIG. 44

Retrofit of Existing Steam Plants

Preferred Embodiment vs. Prior Art

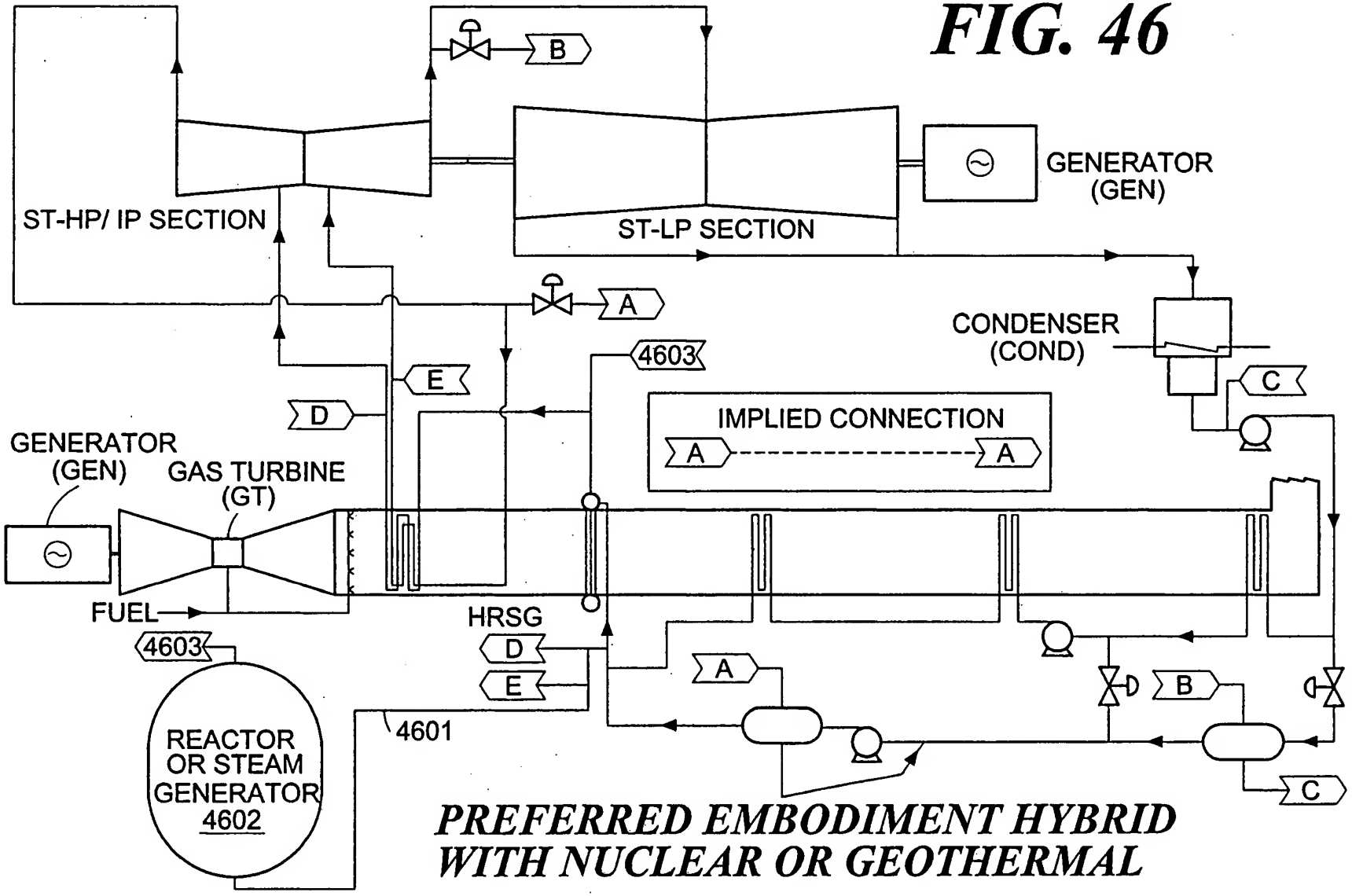
			Steam Turbine Section Flows										
Technology	Steam Inlet Press.	Steam Exhaust Press.	HP Section Inlet Flow	IP Section Inlet Flow	LP Section Inlet Flow	LP Section Exhaust Flow	Gas Turbine Power	Steam Turbine Power	Net Plant Power	Plant Heat Rate	Cost for Steam Turbine Modifi-cations	Total Plant Cost	Plant Cost/ kW
	psia	inch HgA	k-lb/hr	k-lb/hr	k-lb/hr	k-lb/hr	MW	MW	MW	BTU/ kWh	MM US$	MM US$	$/kWh
Conventional Steam Plant (pre-retrofit)	2415	1.20	2,354	2,209	1,815	1,587	0	409	400	7620	N/A	50	125
Prior Art - 1 GT	1815	1.20	439	511	528	528	169	97	263	6090	N/A	N/A	N/A
Prior Art - 3 GTs	1815	1.20	1,317	1,533	1,584	1,584	506	299	798	6040	10	240	301
Preferred Embodiment - 1 GT	2225	1.20	2,182	1,952	1,784	1,593	169	374	535	6235	0	110	206
Preferred Embodiment - 2 GTs	2100	1.36	2,046	1,946	1,900	1,824	338	394	725	6060	0	170	234

FIG. 45



PREFERRED EMBODIMENT WITH CF HYBRID BOILER

FIG. 46



PREFERRED EMBODIMENT HYBRID WITH NUCLEAR OR GEOTHERMAL

FIG. 47

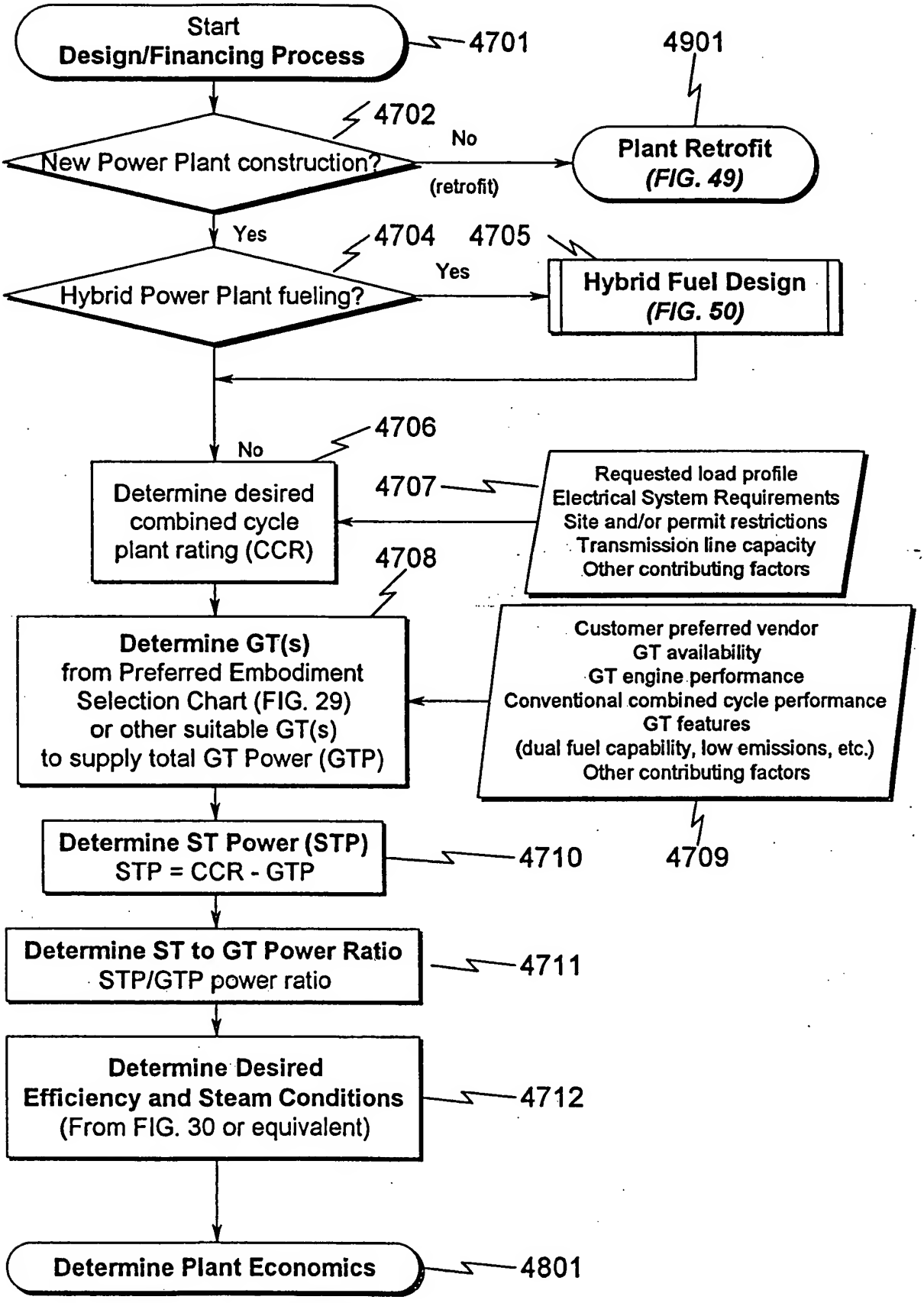

Start
Design/Financing Process
4701
4901
4702
New Power Plant construction?
No
(retrofit)
Plant Retrofit
(FIG. 49)
Yes
4704
4705
Hybrid Power Plant fueling?
Yes
Hybrid Fuel Design
(FIG. 50)
4706
No
Determine desired combined cycle plant rating (CCR)
4707
Requested load profile
Electrical System Requirements
Site and/or permit restrictions
Transmission line capacity
Other contributing factors
4708
Determine GT(s)
from Preferred Embodiment Selection Chart (FIG. 29)
or other suitable GT(s)
to supply total GT Power (GTP)
Customer preferred vendor
GT availability
GT engine performance
Conventional combined cycle performance
GT features
(dual fuel capability, low emissions, etc.)
Other contributing factors
4709
Determine ST Power (STP)
STP = CCR - GTP
4710
Determine ST to GT Power Ratio
STP/GTP power ratio
4711
Determine Desired
Efficiency and Steam Conditions
(From FIG. 30 or equivalent)
4712
Determine Plant Economics
4801

FIG. 48

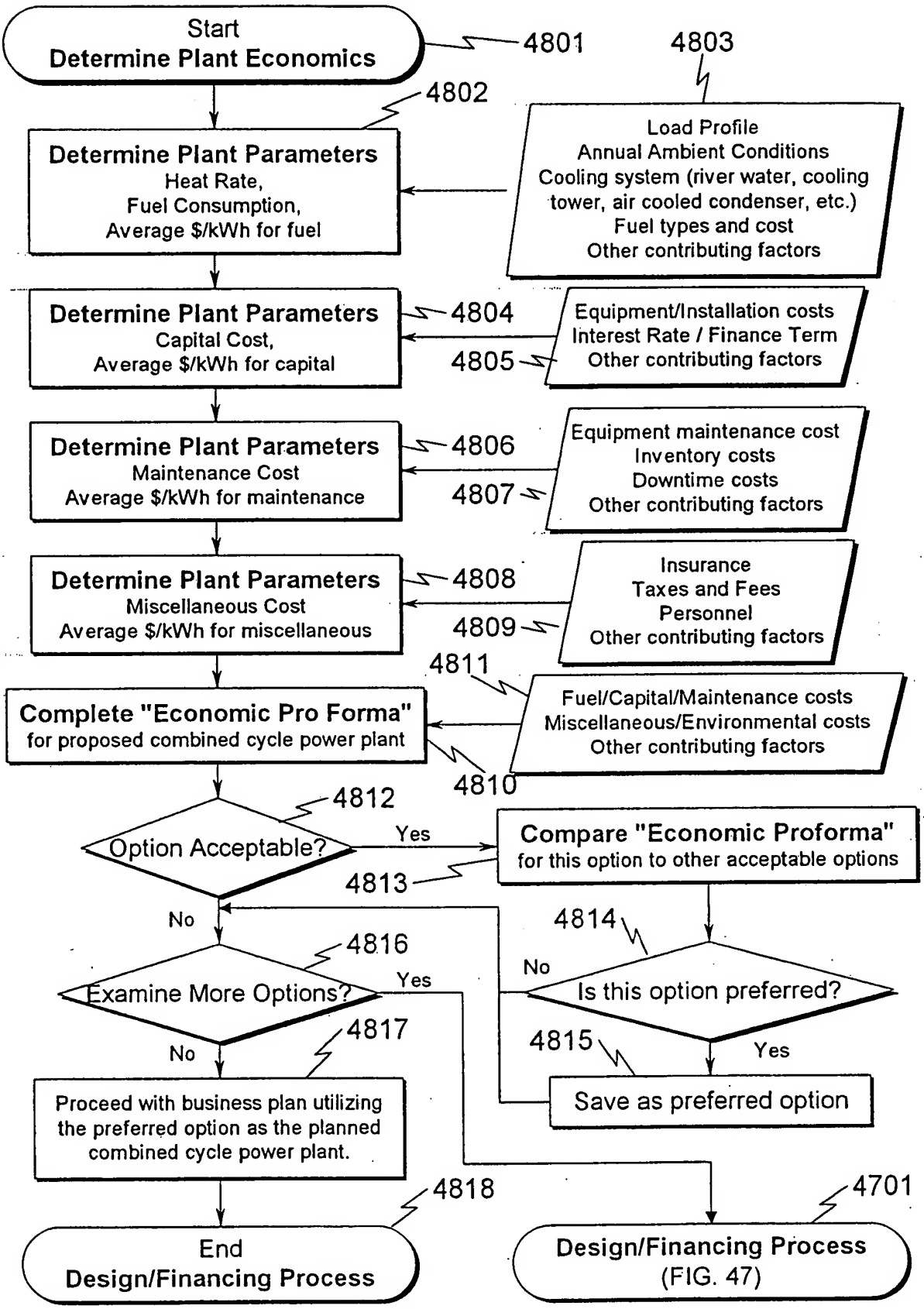

Start
Determine Plant Economics
4801
4803
4802
Determine Plant Parameters
Heat Rate,
Fuel Consumption,
Average $/kWh for fuel
Load Profile
Annual Ambient Conditions
Cooling system (river water, cooling tower, air cooled condenser, etc.)
Fuel types and cost
Other contributing factors
Determine Plant Parameters
Capital Cost,
Average $/kWh for capital
4804
4805
Equipment/Installation costs
Interest Rate / Finance Term
Other contributing factors
Determine Plant Parameters
Maintenance Cost
Average $/kWh for maintenance
4806
4807
Equipment maintenance cost
Inventory costs
Downtime costs
Other contributing factors
Determine Plant Parameters
Miscellaneous Cost
Average $/kWh for miscellaneous
4808
4809
Insurance
Taxes and Fees
Personnel
Other contributing factors
4811
Complete "Economic Pro Forma"
for proposed combined cycle power plant
Fuel/Capital/Maintenance costs
Miscellaneous/Environmental costs
Other contributing factors
4810
4812
Option Acceptable?
Yes
Compare "Economic Proforma"
for this option to other acceptable options
4813
No
4814
4816
No
Examine More Options?
Yes
Is this option preferred?
4817
4815
No
Yes
Proceed with business plan utilizing the preferred option as the planned combined cycle power plant.
Save as preferred option
4818
4701
End
Design/Financing Process
Design/Financing Process
(FIG. 47)

FIG. 49

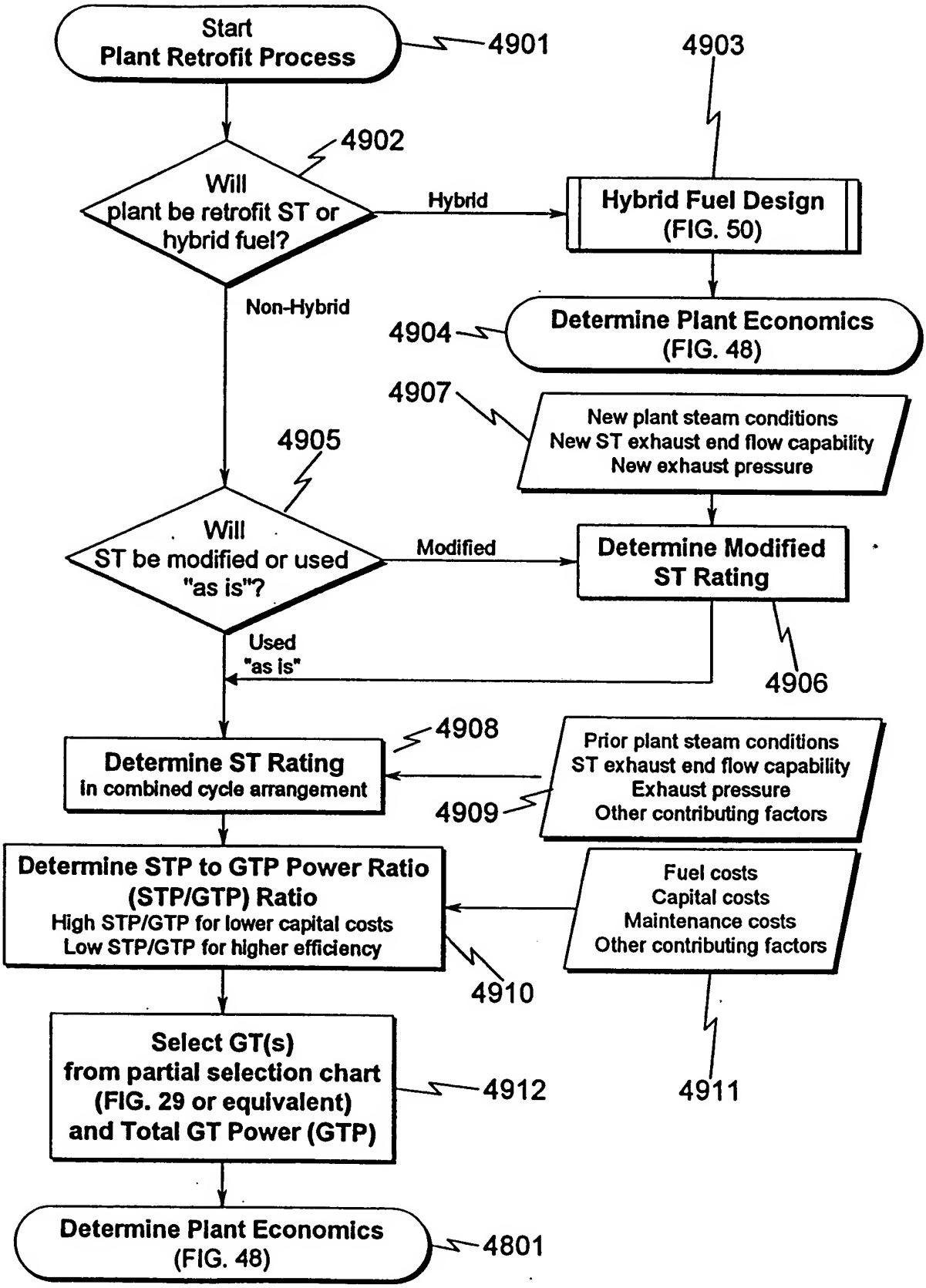

Start
Plant Retrofit Process
4901
4903
4902
Will
plant be retrofit ST or
hybrid fuel?
Hybrid
Hybrid Fuel Design
(FIG. 50)
Non-Hybrid
4904
Determine Plant Economics
(FIG. 48)
4907
New plant steam conditions
New ST exhaust end flow capability
New exhaust pressure
4905
Will
ST be modified or used
"as is"?
Modified
Determine Modified
ST Rating
Used
"as is"
4906
4908
Determine ST Rating
in combined cycle arrangement
Prior plant steam conditions
ST exhaust end flow capability
Exhaust pressure
Other contributing factors
4909
Determine STP to GTP Power Ratio
(STP/GTP) Ratio
High STP/GTP for lower capital costs
Low STP/GTP for higher efficiency
Fuel costs
Capital costs
Maintenance costs
Other contributing factors
4910
4911
Select GT(s)
from partial selection chart
(FIG. 29 or equivalent)
and Total GT Power (GTP)
4912
Determine Plant Economics
(FIG. 48)
4801

FIG. 50

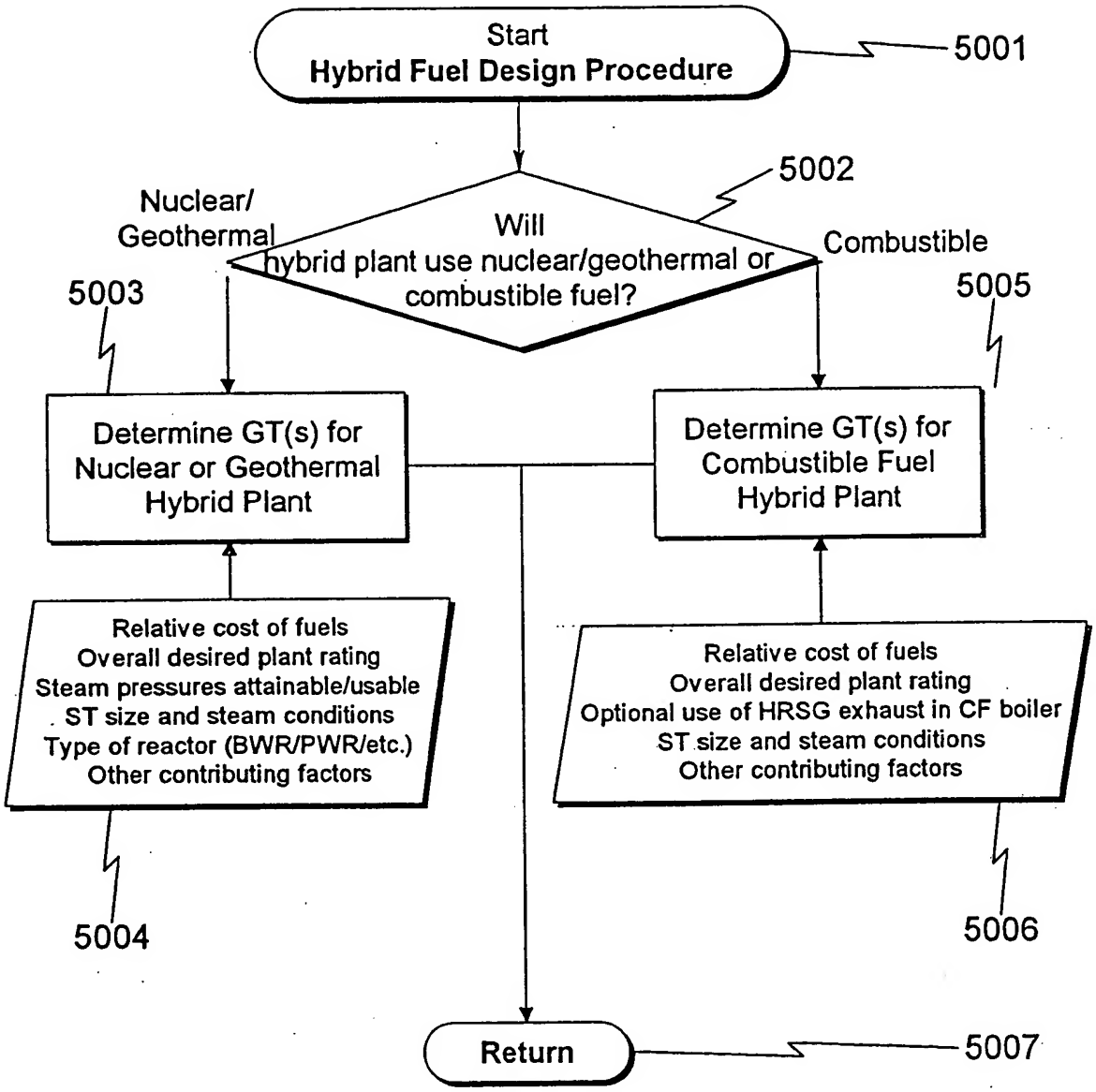

Start
Hybrid Fuel Design Procedure
5001
5002
Will
hybrid plant use nuclear/geothermal or
combustible fuel?
Nuclear/
Geothermal
Combustible
5003
5005
Determine GT(s) for
Nuclear or Geothermal
Hybrid Plant
Determine GT(s) for
Combustible Fuel
Hybrid Plant
Relative cost of fuels
Overall desired plant rating
Steam pressures attainable/usable
ST size and steam conditions
Type of reactor (BWR/PWR/etc.)
Other contributing factors
Relative cost of fuels
Overall desired plant rating
Optional use of HRSG exhaust in CF boiler
ST size and steam conditions
Other contributing factors
5004
5006
Return
5007

FIG. 51

EXEMPLARY THREE-CASING, FOUR-FLOW STEAM TURBINE (GE)